MATERIALS & METHODS

THE METALWORKING INDUSTRIES' ENGINEERING MAGAZINE

ANNUAL ENGINEERING ACHIEVEMENT ISSUE

Announcement of Materials & Methods Awards Winners

Plus

PREVIEW OF NATIONAL METAL CONGRESS AND EXPOSITION

(See page 1193)

NOVEMBER 1946

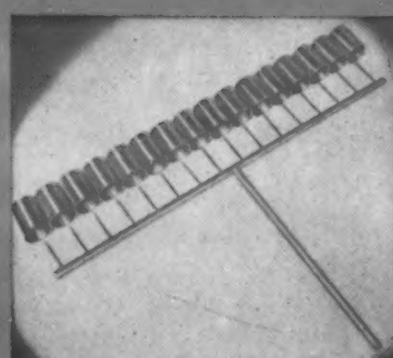
PUBLISHED SINCE 1929 AS METALS AND ALLOYS

They cut the load to her size— with magnesium!

Because it yields important operating economies, The American Can Company has chosen this extruded magnesium fork to replace the previous wooden one for packing cans in cars and cartons. Lighter, stronger, safer than its predecessor—which was subject to splintering—this ingenious device makes good use of magnesium's fabrication advantages, too.

EXTRUSIONS MAKE THIS FORK

Extruded tubes for handle and crossbar, each 1" O.D. by 1/16" wall thickness, are arc welded together. Tines, also extruded, are 5/16" O.D. with 0.094" wall thickness, attached to crossbar with self-tapping screws.



. . . A MORE EFFICIENT TOOL

"Less operator fatigue," says The American Can Company with reference to this magnesium fork. *"The tines do not splinter . . . a simple matter to replace a broken tine—and very little occasion for such breakage to occur."*

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PUBLISHED SINCE 1929 AS

METALS and ALLOYS

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blished Monthly by Reinhold Publishing rporation, 330 West 42nd St., New York 8), N. Y., U. S. A. Ralph Reinhold, Chairn of the Board; Philip H. Hubbard, President; H. Burton Lowe, Executive Vice President and Treasurer; G. E. Cochran, Vice resident and Secretary; William P. Winsor, ce President; Francis M. Turner, Vice esident. Price 25 cents a copy. Annual bscription: U. S., Possessions and Canada, .00. All Other Countries, $3.00. (Remit New York Draft.)

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Printed by tus Press, Inc., 508 West 26th St., New rk 1, N. Y.

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Reitered as second class matter Nov. 14, 45, at the Post Office at New York, Y. under the Act of March 3, 1879.

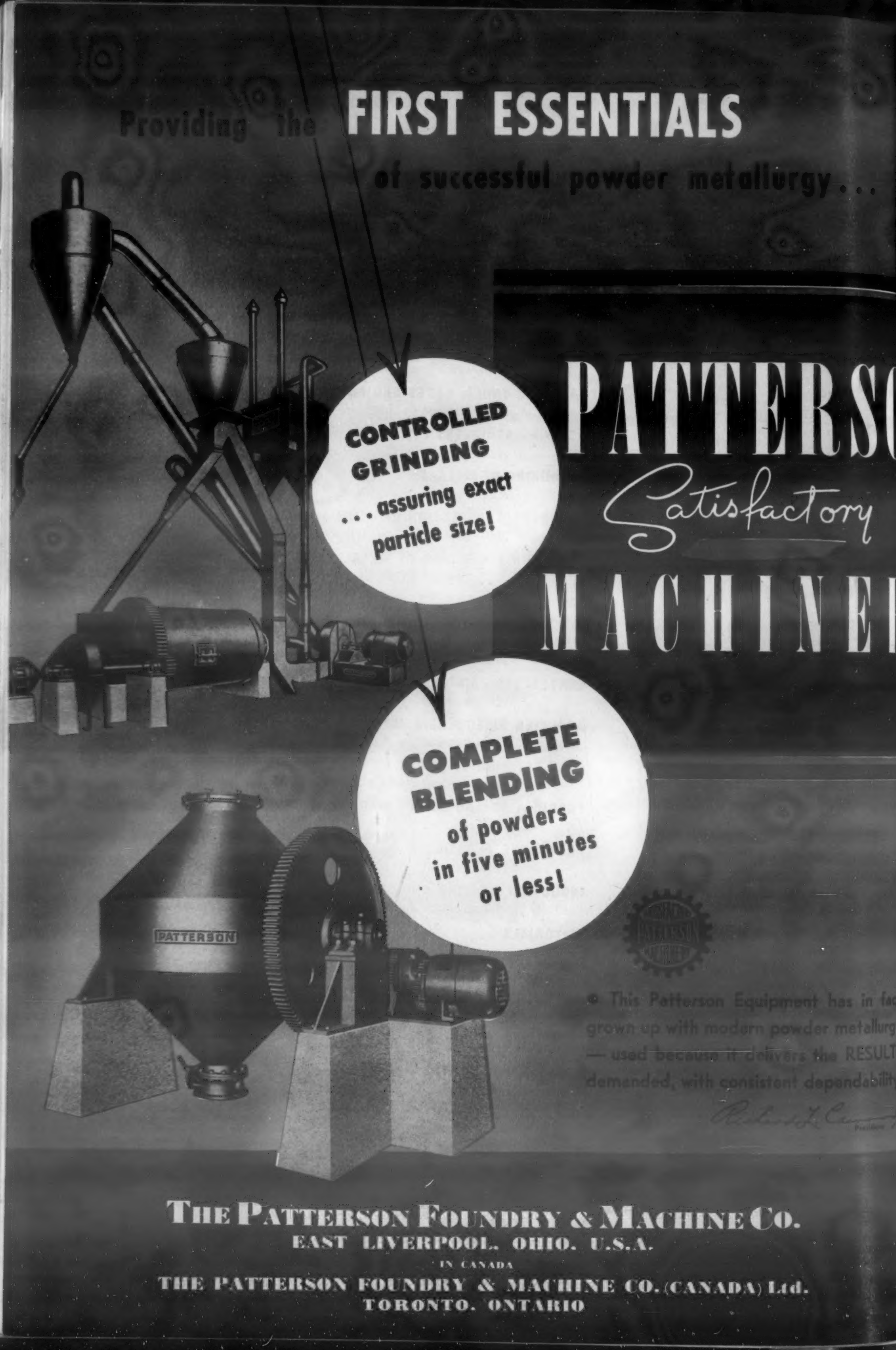
RP REINHOLD

MATERIALS & METHODS

Volume 24, Number 5 November, 1946

NEXT ISSUE:

Magnesium in Electrical Batteries
Radar Transformer Steel
Printed Electrical Circuits
Fabricating Sheet for Jet Planes
Drying Industrial Finishes
Finned Cylinder Made by Precision Casting
Cold Treatment of Steel
Copper-Base Powder Metallurgy Parts
Casting Resins
NICKEL AND HIGH NICKEL ALLOYS: "Materials & Methods Manual" No. 21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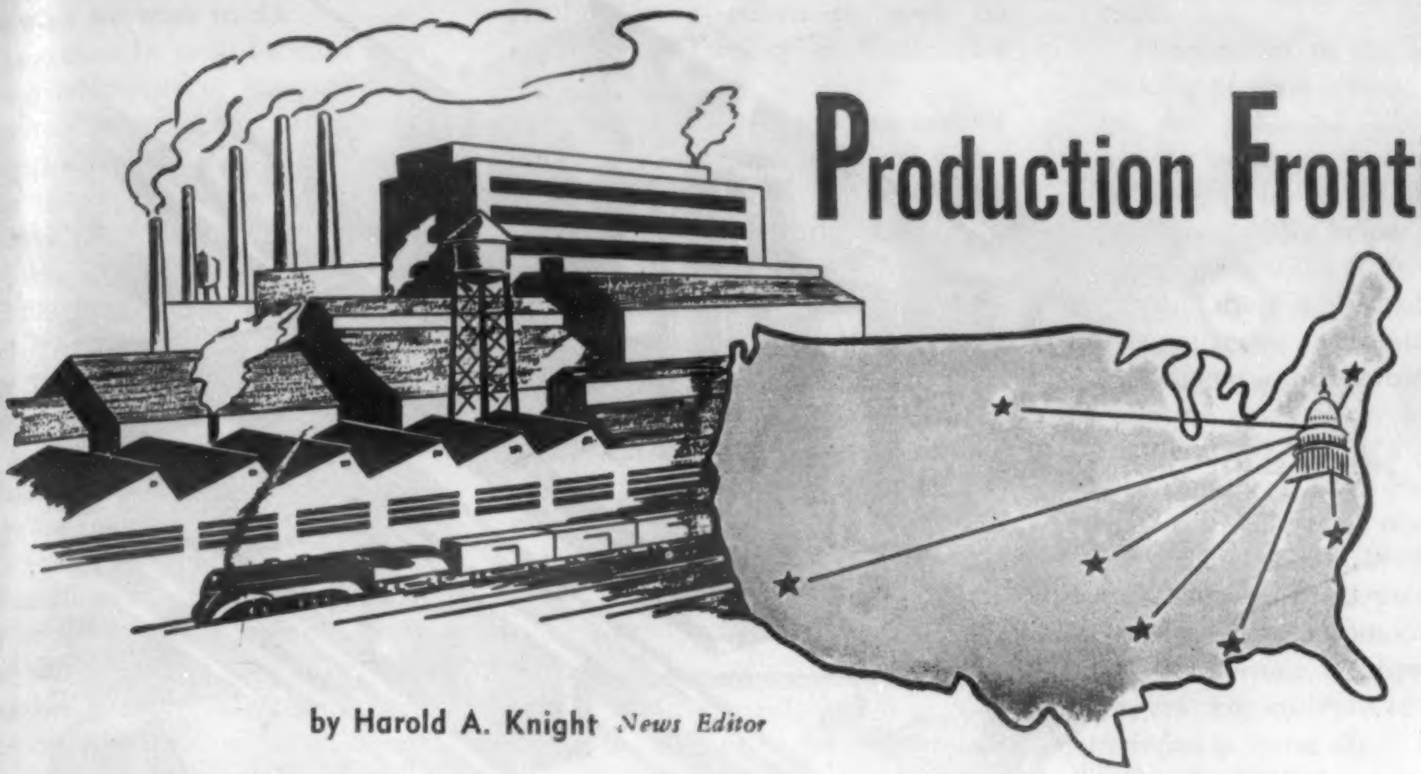


Production Frontiers

by Harold A. Knight *News Editor*

Looking Through Rose-Colored, Then Blue, Glasses

We've been a sourpuss so often in these columns as to the state of the nation these many months that we wish to vary the monotony by marshalling some of the better factors—not but that we may drift back again to the bluer side.

We'll start off by quoting the best authority in Washington on this particular subject, who stated that production of softwood and plywood (housing grades) since V-J Day has increased over 614%. Production of steel ingots and castings during August set a postwar record, at 6,895,465 net tons, an average rate of 88.3% of capacity against 70.7 a year before.

John D. Small, that dynamic and down-to-earth Administrator of Civilian Production, has given out figures in production of consumers' durable goods for July, compared with the prewar monthly rate. We will mention only the favorable comparisons. Production of trucks was 93,000 units, up about 6,000 from the prewar monthly rate.

Output of passenger tires was 5,100,000, up 900,000; truck and bus tires, 1,100,000, up 100,000; washing machines, 187,000, up 29,000; radios, 1,329,000, up 229,000; vacuum cleaners, 197,000, up 41,000; gas ranges, 127,000, up 2,000; electric ranges, 57,000, up 10,000; electric irons, 502,000, up 122,000.

To paint a true picture, of course, we must record the scarcities, and in doing so we'll quote almost verbatim what another Washington expert (policy forbids our mentioning him by name) told us.

The tin stockpile is desperately and dangerously low, and this expert gets very nervous over it. There'll be no relaxation in tin until the end of 1947. Pig iron supply is considerably below what the country needs. Steel scrap has dried up, with 600 persons investigating scrap inventories, to see where hoarding is going on. Copper supply is still low but production has gained rapidly since the copper workers' strike. Lead is very serious —so is secondary lead, for people are not collecting old batteries and some place or other supplies are damming up.

Production of automobiles, refrigerators and vacuum cleaners will continue to be disappointing because of steel shortage, and even with abundant steel the lack of workers will retard. Deep drawing, enameling, electrical and galvanized steel will be a problem for many months. Copper wire and magnet wire are bad, but improving. Hardwood flooring is extremely bad, and there is a plaster shortage. A very bad situation exists in nails.

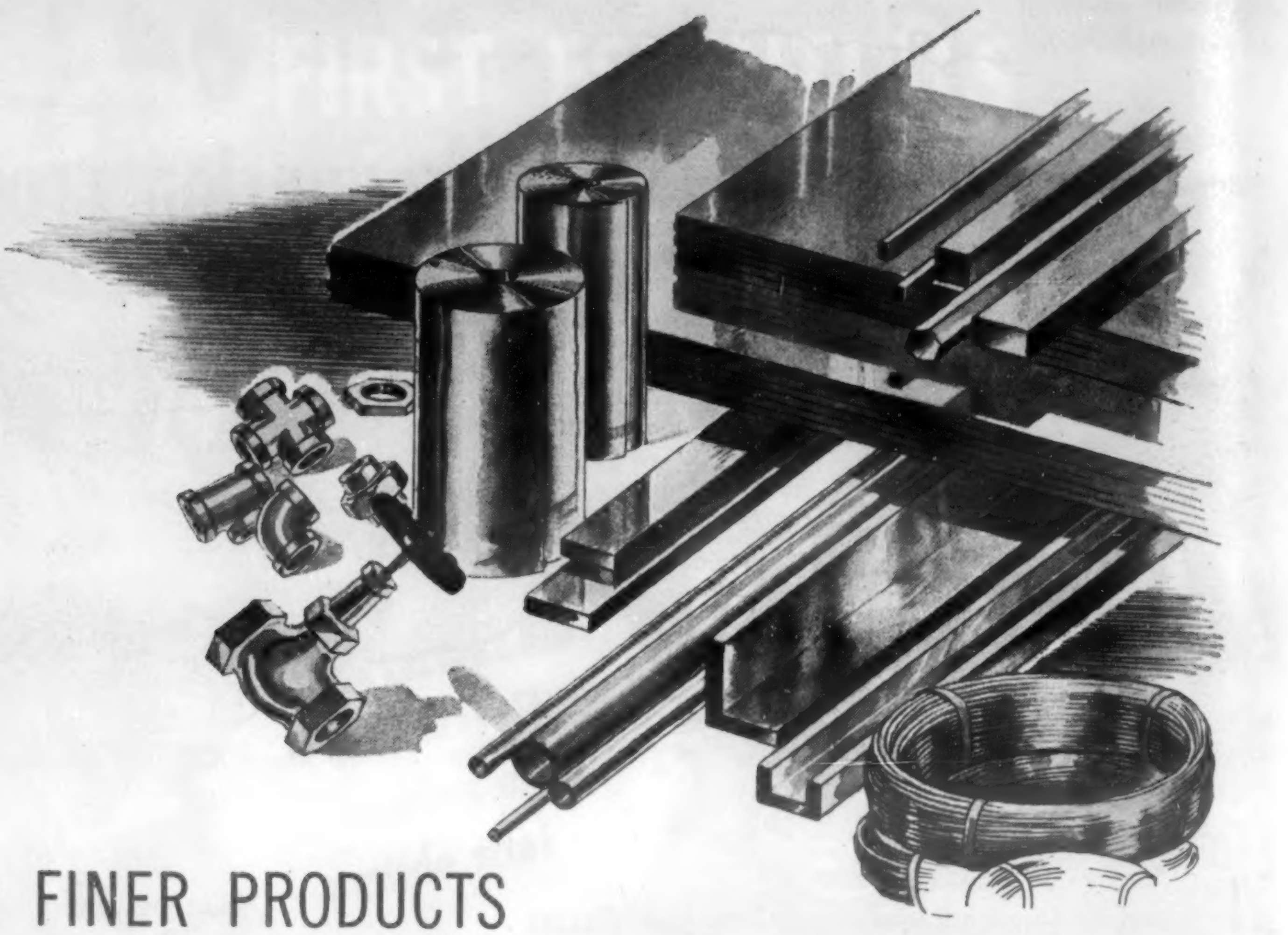
Though price and allocation controls expire by law on March 31, 1947, some controls must be extended, according to this authority, particularly on tin, crude rubber, antimony, lead and uranium. The expert predicted a severe labor shortage by fall and mentioned present scarcities among plumbers and carpenters and core makers and molders.

The Washington bigwig paid steel makers a sincere compliment by observing: "They have done a grand job in their voluntary rationing of steel." He concluded by stating: "If and when we remove controls, I do not fear inflation, though prices will rise at first."

Labor-Management Situation

What's new in labor-management thinking and action? Speaking of the theory of a guaranteed annual wage, Henry Ford II, appearing before the Economic Club of Detroit, described it as a "political phony." He said: "It suggests that someone is in a position to guarantee an annual wage and is merely refusing to do so.

"Both management and labor will undoubtedly have to adopt new points of view if we are to approach even in one industry new horizons in level employment. We must learn how to increase production efficiency so that we can make more motor cars at



FOR FINER PRODUCTS

Stainless steel is available in many forms

When you are planning new equipment, you will find stainless steel available in a form to suit your purpose. Bars, sheets, strip, angles, tubing, wire, valves, and fittings are some of the many forms available. This metal, so hard to get during wartime, is now ready for use wherever strength, resistance to corrosion, or surface beauty are required. Stainless steel is readily fabricated into a variety of products from tableware to streamlined trains.

If you are interested in some of the new and varied uses of stainless and other alloy steels, ask to receive the monthly publication, ELECTROMET REVIEW. Or, if you need information on the production, properties, or fabrication of these steels, write our Technical Service Department. We do not make steel but we do produce the ferro-alloys which are used in its manufacture, and our engineers have accumulated a fund of information on the use of stainless steel in many industries.

ELECTRO METALLURGICAL COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
30 East 42nd Street, New York 17, N. Y.
In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

STAINLESS STEEL — BEAUTIFUL ENDURING STRONG TOUGH

lower cost and thus earn the money to do what we want to do.

"There must be great forward steps in the productivity of *machines* and an increase in productivity of *men*. We must solve the pressing problems of the human factor in production. And here, vigorous fresh thought is called for.

"Throughout history it has been necessary for people to make the choice between freedom and seductive promises of security. When freedom goes, security goes with it. The offer of every tyrant is security in exchange for freedom. Yet it is freedom which has given more real security to more millions of people here than enjoy it in any other great country in the world."

Another great thinker and noted writer on economic subjects, Stuart Chase, in discussing our ability to win the peace, put it this way in his new report, "For This We Fought": "Keeping the business cycle in line, providing full employment, spreading social security to all who need it, administering the debt, easing atomic energy into industry—none of these tasks will be easy. But in comparison with the physical achievements of making 297,000 airplanes from scratch, helping to beat Germany with one hand and Japan with the other, they are kindergarten work.

"The 'bums and loafers' of 1940 turned into foxhole heroes. The flying fools and the dauntless naval crews of 1944 were equally heroic. The 'scum of the earth' from the Dust Bowl built B-29's from San Diego to Seattle.

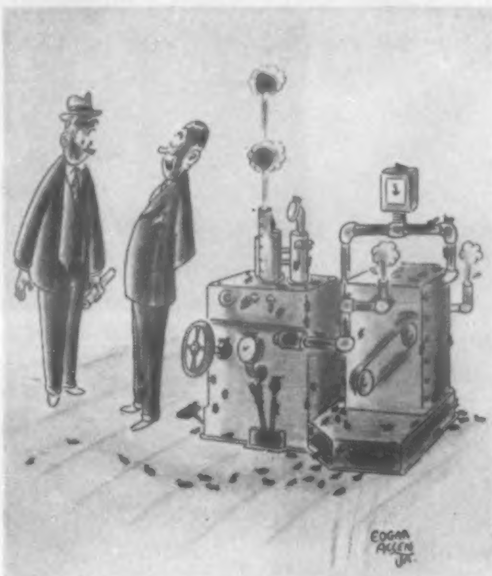
"Imagine, if you can, what the achievement might have been had the goal been life rather than death; building new cities for the power age, rather than smashing existing cities to rubble! People must have a goal to stir them to activity; something big to do, to make sacrifices for."

Modern Glass Blowers

Our maternal parent used to tell us about the glass blowers in her little home town in upstate New York and what fabulous people they must have been! Highly skilled and cocky, they conducted their personal affairs in ways best suited to individual convenience, heeding slightly, if at all, the rules laid down by their employers or the laws of the village, state and country in which they lived. Saturday night celebrations usually resulted in a return to work no earlier than Tuesday or Wednesday morning.

Remembering many weird tales of the past, we saw modern glass blowers at the Corning Glass Works, Corning, N. Y., recently. Of course, the bulk of this glass is now largely machine made. Yet the famous Steuben glass, the apple of Milady's eye, is still done the old fashioned way.

Methods might seem to be "by guess and by gob" (gob of molten glass), yet on second consideration one realizes that it is long developed instinct, perhaps inherited by son from father, which impels one workman with tongs to snip off just the right amount of molten glass for, say, a cream pitcher which will retail for $7. It is instinct which teaches him to twirl the tongs plus glass in the way of a drum major for just the right split second amount of time for cooling, the twirling being designed for keeping the hunk of glass symmetrical. It must be instinct which teaches the blower how much blowing and at what pressure and the right amount of twirling of the blowpipe.



"I'd have entered it in the Achievement Contest if I had gotten all the bugs out of it!"

Instinct enters, too, in fastening on the glass handle. Both body and handle must be of the correct temperature to fuse together properly. Equally fascinating was it to watch crystal clear goblets, retailing at $140 per dozen, being blown and fabricated.

Phenomenal to the layman is the making of glass tubing, such as used in the chemical laboratory. The blower stands in position and starts blowing to make the chunk of glass hollow while his helper runs with the other end to some 30 ft. distant. Presto—and there is glass tubing which to the eye seems micrometer perfect.

Your typical glass blower is an interesting study all by himself. He is "fat and 40," with a well-barbered and contented look. He seems to be a good family man who is happiest, perhaps, when he takes the family out on a Sunday for a picnic in an expensive, shiny automobile. He never has to consult a physician for his nerves. His constant blowing has developed a broad chest and kept him generally healthy.

Outside of the hand-made goods department it was intensely interesting, too. We saw furnaces, molds, and methods, the like of which we had never seen before. We might have thought that all of us, men and machinery, were on Mars, until—we saw a young fellow bend over and light a cigarette from a red hot glass household fuse passing on the conveyor belt—then we knew we were still on earth and in the U. S. A.

Columbium Aids Bigamy

Some of our most vital metals come from afar, and their mining and transportation involve some bizarre situations. Recall in our July issue our little piece about the metal of "Love and Beauty," named after the Scandinavian goddess of those attributes—vanadium, mined in the Peruvian Andes, and at first transported by llamas.

An equally romantic metal is columbium, dug up in Nigeria by black men, with several wives each, and with mining done to the music of drum and flute. Don't think the women are mere pets or ornaments. They and their children help transport the pay dirt in big metal pans.

Steelways for September, published by the American Iron & Steel Institute, carries a very readable sketch on this metal that "stabilizes" stainless steel for use at temperatures at 1500 F. Around 1929 metallurgists of the Electro Metallurgical Co. were seeking to make superior stainless steels. One of the best was the chro-

Why SHARON STAINLESS *Fabricates Easier*

Stainless steels are precisely made. Their fabrication requires more careful planning and control than ordinary metals.

In the case of Sharon Stainless, we can say "It's easier to fabricate." Here's why. Sharon's metallurgical staff not only supervises closely the production of Sharon Stainless, but also works with users in selecting the proper grade and in advising as to fabrication methods.

Fabricators have fewer production difficulties when they consult Sharon's stainless steel specialists whose energies are devoted untiringly to finding the correct solution to countless problems of the metal-working industry.

SHARON STEEL CORPORATION
Sharon, Pennsylvania

mium-nickel type, but between 800 and 1500 F it became susceptible to intergranular corrosion. The chromium combined with the carbon to form chromium carbides between the grains of steel. This is bad because the chromium should remain evenly distributed throughout the alloy.

Now, when columbium is around, Miss Carbon, a fickle gal, considers Mr. Chromium merely small potatoes, hence teams up with columbium while the steel is being made, forming harmless columbium carbides which do not interfere with the alloy's structure. (Of course, titanium doesn't do too badly as a substitute for columbium—but that's another story.) The atomic weight of columbium is about eight times that of carbon, hence eight parts of columbium to each part of carbon will stabilize the mixture—a ratio of 10 to 1 is even better.

The sudden rise in the use of turbosuperchargers, jet engines and gas turbines made necessary the development of superalloys that could hold up to this severe heat. A British scientist, Charles Hatchett, discovered in 1801 that certain hard, dull-black crystals which the British Museum had obtained from Haddam, Conn., had properties unlike those of any mineral then known. Since the United States was popularly known as "Columbia" in those days, "columbium" became the name of the metal and "columbite" the mineral containing the metal.

Widespread search revealed large quantities in Nigeria, on a plateau in Bauchi Province. American imports of columbium rose to 600,000 lb. in 1940 and very much higher during the war, exact figures still being military secrets. When the war was over, it was the last metal removed from allocation, with the exception, of course, of uranium.

The black workers of Nigeria frequently removed as much as 35 ft. of soil, gravel and rock before they expose the alluvial vein of blackish metallic sand and pebbles. At the vein exposure the musicians play with renewed gusto, the ensuing "jive" session being plainly "out of this world." Those who do not play the woodwinds or percussion instruments chant and sing. Surely the birth of no metal is ushered in with more fervor.

When taken by jubilant natives to the concentrating point, the ore is subjected to various operations to remove impurities, is loaded in trucks for further transport by ship or plane. In the United States it is processed into ferro-columbium, selling for $2.25 per lb. But during the war it was much more precious than its dollars and cents value might indicate. Care was taken not to concentrate too much metal in one plane or ship in case of accident.

Columbium has brought prosperity to Nigeria, and made it easier for the black men to support their four or five wives each. May the drums and flutes play many a year hence!

The Fish-Hook Seems a Simple Thing

You Isaak Waltons—where do you suppose fish hooks come from? Can most anybody make a good fish hook? What about holding temper during the process of point grinding—a neat bit of a heat-treating trick, eh what?

The most intriguing little heat-treating-human interest tale we've heard in a long time was recently presented by Lindberg Steel Treating Co. in their miniature house organ or regular promotion piece. Allow us to tell you the sum and substance of that piece.

"The fingers of two hands will count all the quality fish hook makers of the world," states Lindberg. A few fishing fans talk knowingly of Heming, Allcock and Mustad, fish hook makers of England and Norway. Most of the quality fish hook makers were found in the little town of Redditch in the English Midlands where for centuries fathers taught sons—not only fish hook manufacture, but also surgeon's and ordinary sewing needles.

In the United States several firms have been producing fine hooks, and a few have succeeded in equalling the Redditch products. The matter of temper stands between superior hooks and the common garden variety. For the tough game fish, if one can't have the best one might as well use a bent pin.

Any good heat treater can give steel wire the proper temper, but that temper must be held while the sharp point is ground. That is the secret handed down from father to son, yea, through the third, fourth and many generations thereafter!

Continues Lindberg: "When you are in a sporting goods store, pick up a trout fly—say a Colonel Fuller in size 14. Examine the ½-in. long hook less than ¼-in. between point and shank. Think of this little instrument impaling and holding a slashing brown trout weighing 5 or 6 lb. First, the tiny point must pierce the scaly, shell-like hard tissue of the upper lip or jaw. Then the even tinier barb must take hold so that the wily fish cannot throw it from his mouth. And the hook must retain its curve or the pull would tear it out, barb and all."

Wonder how the fishing will be down in Florida this coming winter?

Greenish Yellow: Maybe Uranium

We've picked up a few bits of information about uranium that are perhaps off the beaten path. Where was uranium used in ceramics, for instance? W. E. Dougherty, of the O. Hommel Co., supplies the answer. Until the start of World War II, uranium was used quite extensively in ceramics—but it will probably never be so used again.

Its principal ceramics use was in making a red glaze for pottery ware. Also, a uranium compound was used for making yellow and ivory colors. "Fiesta Red" was a big user. It was employed in making yellow glass for tableware, architectural glass and ornamental glass. It had other decorative uses, such as jewelry enamel.

Interesting, too, is some data on how uranium is discovered in the field and further confirmed in the laboratory, as told by Jack De Ment, head of Fluorescence Laboratories, Armour Research Foundation. Thus, with the portable Mineralight ultraviolet light unit the ore can be detected by its distinctive and colorful fluorescences. The secondary uranium minerals fluoresce yellow to green, and a simple acid treatment of many primary uranium ores will result in fluorescence.

Under ultraviolet light, which has been rendered free of visible rays by transmission through a dark purple glass filter, many uranium minerals make their occurrence known to the prospector. The fluorescence is seen exclusively in the secondary uraninites, which have been altered by weathering to uranyl compounds. The observation of secondary ores in an outcropping implies existence of primary ores beneath. In the Great Bear Lake area of Canada, the tell-tale signs are due to the secondary ore, zippeite.

News of

Engineers — Companies — Societies

Engineers

Maj. Gen. Henry S. Aurand has been made director of the Research & Development Div., War Dept. General Staff, being concerned with the application of national scientific resources to the solution of military problems. At the moment he is bringing into his division top-flight engineers and scientists from laboratories of educational institutions, foundations and industries.

John E. Capell has been appointed chief production engineer for Aerolite Engine Co., Inc., Bayonne, N. J., industrial and marine engines. He was formerly a tool engineer with Stevenson, Harrison & Jordon, and has been with Sperry Gyroscope Co., Inc.

George P. Eichelsbach, Jr., has become director of manufacturing and engineering, American Stove Co.'s St. Louis plant, having started with the company as engineering draftsman. During the war he headed a committee on manufacture of 40-mm. shells.

William J. Kerr has been made vice president in charge of production, the Yoder Co., Cleveland, having been factory manager since 1941. During the war, he served in the development of the 57-mm. gun and 105-mm. shell. Previous connections were with Worthington Pump & Machinery Corp. in Cincinnati, and as industrial engineer at New York.

Frank Brunner, former assistant superintendent, main plant, Stearns Magnetic Mfg. Co., Milwaukee, has been advanced to superintendent of the company's brake factory.

George L. Tuer, Jr., has joined the physics section of the Midwest Research Institute, Kansas City, having previously been with the research laboratories, Aluminum Co. of America.

E. A. Tice has joined the International Nickel Co., Inc., at New York as a corrosion engineer, having previously been associated with Bethlehem Steel Co. in a similar capacity.

J. P. Martel has been made manager of the Design Div., Engineering Dept., E. I. du Pont de Nemours & Co., Inc. *F. W. Pardee, Jr.*, has been named assistant manager. Mr. Martel joined du Pont in 1919 as assistant engineer in dyestuffs operation. Mr. Pardee joined the company in 1928.

Dr. George B. Hatch, who has specialized in detergents and "Threshold" treatment for 10 years on the research staff of Calgon, Inc., Pittsburgh, has been assigned to research on "Banox," the company's new protective treatment of metal surfaces.

Fayette Leister, who has served for a quarter century as an anti-friction bearing engineer, has become vice president in charge of engineering of the Fafnir Bearing Co., New Britain, Conn. He served in the first World War as an Army engineer.

R. J. Leckrone, who has had international experience as a chief designing engineer of rolling mill equipment, etc., has been made chief engineer in charge of engineering and machinery sales of the Pittsburgh Steel Foundry Corp., Glassport, Pa. He served three years in Russia in design and installation of rolling mills.

Dr. C. K. Bump and *H. W. Mohrman* have been made assistant directors of research of the Plastics Div., Monsanto Chemical Co. The former will be in charge of general application and technical service, while the latter will head the physics and physical testing sections.

Dr. M. E. Fine and *F. J. Schnettler*, both formerly with the Manhattan District Project at Los Alamos, N. M., have joined the technical staff, chemical laboratories, Bell Telephone Laboratories, Murray Hill, N. J.

H. R. McLaren, formerly superintendent of tube mills, Steel & Tube Div., Timken Roller Bearing Co., has been made assistant general superintendent. *J. P. Wargo*, assistant superintendent of tube mills and finishing departments, becomes superintendent of tube mills. *R. R. Elsasser*, formerly manager of the company's Newton Falls, Ohio, plant, becomes assistant superintendent of tube mills.

J. E. Fifield, formerly with the U. S. Naval Research Laboratory and the American Brake Shoe Co., has joined the Development & Research Div., International Nickel Co., Inc., with headquarters at Hartford, Conn. By education and experience he is a metallurgist.

Dr. Frances H. Clark has resigned as metallurgist with the Western Union Telegraph Co. to join A. R. D. Corp., 65 Pine St., New York 5, specializing in applied research and development.

H. H. Fairfield has been appointed to the staff of H. W. Dietert Co., Detroit 4, as foundry consultant. He has been engaged as a metallurgical engineer with the Physical Metallurgy Research Laboratories in Canada since 1940, specializing in quality control in metallurgical processes. A number of technical papers describing his work in metallurgical and foundry fields have been published.

James C. Hartley has become chief metallurgist for Barium Steel & Forge, Inc., having formerly been director of research for the Heppenstall Co., Pittsburgh. He holds patents on direct reduction of iron ores, beryllium reduction and steel processes. He is co-discoverer of the Dolan-Hartley beryllium alloys process.

Companies

The *United States Steel Corp.* will spend $100,000,000 in expanding its steel plants on the Pacific Coast.

The *Chase Brass & Copper Co.* has bought the Government-built war plant at Euclid, Ohio, for $5,012,522. The sale includes 100 acres of land and some of the plant's equipment. Eventually all of the sheet brass made by Chase in Euclid will be manufactured in the newly-acquired plant.

The *Steel Improvement & Forge Co.*, Cleveland, has established a Turbine Forgings Div., which will consist of a specialist in every phase of the production of forgings of high temperature alloys and quality control. It is in charge of Carl I. Schweizer, chief metallurgist.

Industrial Ovens, Inc., is the new name for *Industrial Oven Engineering Co.*, which

(Continued on page 1306)

Meetings and Expositions

- AMERICAN SOCIETY FOR METALS, annual meeting. Atlantic City, N. J. Nov. 18-22, 1946.
- AMERICAN WELDING SOCIETY, annual meeting. Atlantic City, N. J. Nov. 18-22, 1946.
- AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, Iron & Steel and Institute of Metals Divs. Atlantic City, N. J. Nov. 18-22, 1946.
- NATIONAL METAL CONGRESS AND EXPOSITION, Atlantic City, N. J. Nov. 18-22, 1946.
- AMERICAN INDUSTRIAL RADIUM & X-RAY SOCIETY, annual meeting. Atlantic City, N. J. Nov. 19-22, 1946.
- SOCIETY OF AUTOMOTIVE ENGINEERS, national air transport engineering meeting. Chicago, Ill. Dec. 2-4, 1946.
- AMERICAN SOCIETY OF MECHANICAL ENGINEERS, annual meeting. New York, N. Y. Dec. 2-6, 1946.
- AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, Electric Furnace Steel Committee, annual meeting. Pittsburgh, Pa. Dec. 5-7, 1946.
- SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS, annual meeting. New York, N. Y. Dec. 9-11, 1946.

AN EDITORIAL

Wise Words from an Award Winner

We are happy and honored to announce in this issue (page 1153) the names of the winning candidates in the first MATERIALS & METHODS Achievement Award, just concluded. The First Award winner, J. O. Almen of General Motors Research Laboratories, was chosen for this honor by the judges from a large field of entries, many of them based on some of the most spectacular or dramatic technical developments of the war period. Mr. Almen's work on pre-stressing can hardly be classed as "glamorous," but it was outstanding for the breadth and depth of its influence on the design and production of hundreds of war and postwar products.

Your editors are particularly pleased with the Judges' decision because it honors a *processing* development that has a basic and profound effect on *material* quality and thus adds important proof to our contention that sound engineering must increasingly correlate materials and processing methods. This type of correlation necessarily involves the close collaboration everywhere of the engineering, production and metallurgical departments—a collaboration which unfortunately is still absent from many of our manufacturing plants.

With respect to this collaboration and the urgent need for its extension, Mr. Almen himself wrote the rest of our editorial when he had this to say in the July 1943 issue of *S.A.E. Journal:*

"Although no super-strength alloys have been discovered and no such discoveries seem imminent, there is much that can be done to increase materially the fatigue strength of many machine parts [and thereby their service performance or design] made from our ordinary structural materials. . . .

"Fully 90% of all fatigue failures occurring in service or during laboratory and road tests are traceable to design and production defects, and only the remaining 10% are primarily the responsibility of the metallurgist as defects in material, material specification, or heat-treatment. . . .

"The study of fatigue of materials is properly the joint duty of the metallurgical, engineering, and production departments. Unless all of these departments have an understanding of fatigue phenomena and the factors that promote fatigue, they cannot recognize their individual responsibilities for the product they manufacture. There is no definite line of demarcation between mechanical and metallurgical factors that contribute to fatigue, and there must, therefore, be very close cooperation between the metallurgist and the engineering fatigue specialist, if such there is, or the metallurgist must possess the qualifications of the metallurgist, designer, and machinist.

"This overlapping of responsibility is not sufficiently understood in industry, and hence the engineers are constantly demanding new metallurgical miracles, instead of correcting their own faults. It would be very helpful if the metallurgists would be less willing to look for metallurgical causes of fatigue and insist that equally competent examination for mechanical causes be made. Until this is done, we cannot hope to make full use of our engineering materials."

All of which is even more true today than it was in 1943! FRED P. PETERS

Bars of A4615, like all Ryerson Alloys, are unmistakably identified by color marking and heat symbol. When transferred to the Ryerson Alloy Report, marking and symbol give a positive check between steel and accompanying hardenability data.

Now Back in Ryerson Stocks

A4615-A4140-A4150 and other prewar alloys

Old friends, the alloy steels for which Ryerson stocks were distinguished in the days before Pearl Harbor, are back from war. They have been at the front for more than four years but now their special war jobs are finished and these steels are again available to everyone for prompt shipment from eleven Ryerson plants.

Of course the wartime triple alloys which proved satisfactory have been adopted as standard AISI steels and continue in Ryerson stocks. Both prewar and triple alloys in a wide range of sizes make your nearby Ryerson plant the ideal source for every alloy requirement.

In addition, Ryerson alloy service provides the advantages of the Ryerson Certified Steel Plan, featuring a time-saving Alloy Report with every shipment. The chemical analysis, heat treatment response and recommended working temperatures included in the report are a helpful guide for designers and heat treaters, a reliable record for purchasing men.

Diversified stocks plus the quality assurance of the Certified Steel Plan are two reasons why more manufacturers depend on Ryerson for alloy steel from stock than on any other source. Whatever your alloy requirements, let Ryerson specialists work with you to supply the steel you need, when you need it. Call, wire or write the nearest Ryerson plant.

**JOSEPH T. RYERSON & SON, INC., Steel-Service Plants at: Chicago · Milwaukee · Detroit
St. Louis · Cincinnati · Cleveland · Pittsburgh · Philadelphia · Buffalo · New York · Boston**

RYERSON STEEL

Editorial Comment

Another Editorial Achievement Award for M & M

Just as general literature in America has its Pulitzer prizes and the movie industry its Academy "Oscars," so also are the industrial, technical and trade papers honored annually for their best work. For nine years the magazine *Industrial Marketing* has conducted an Editorial Achievement Award, giving plaques and certificates for the best single articles, series of articles, editorials, special issues and editorial research, as well as for the best typographic and illustrative work appearing in business and technical journals. A total of 25 to 30 awards are made each year out of a field of currently more than 400 entries.

This year MATERIALS & METHODS won its ninth editorial achievement award. We are particularly proud of our continuing record of having won more of these editorial achievement awards since the inception of this competition than any other magazine in existence! The nearest approach to M & M's nine awards is the seven-award total reached by a magazine in an entirely different field.

The Award this year was an Honorable Mention in the "best single article" classification, for E. L. Cady's comprehensive and informative Manual on "Cutting Oils," published in our August 1945 issue. This Manual made an enormous hit with our readers, many classing it as the best article ever published anywhere on this important topic. Mr. Cady's Manuals have all been exceptionally well-received, but we are glad to pay him public honor at this time for his particular contribution that won this Award. —The Editors.

Materials from Alloying

A major factor in producing new and important engineering materials in the last few years has been the development of new alloy steels and new special alloys. This has been so vital a factor to the designing engineer and to others that a brief review of some of the highlights seems appropriate.

We read with keen interest recently an article on permanent magnet steels, written by an authority in this field. It impressively illustrates the fact mentioned above. Since early in this century these magnet steels have been revolutionized and expanded by alloying. In the early 1900's, the then available permanent magnet steels were of very simple composition. But since then, by the use of such alloying elements as aluminum, molybdenum, vanadium, nickel, cobalt, silver, etc., some materials of significant magnetic properties have been made commercially available. These have found many useful applications.

Outstanding among these newer materials are the stainless steels, practically unknown about forty years ago. By the addition of chromium and then nickel to ordinary steels, a product has been developed which has revolutionized many industries. And by the further addition of columbium, titanium, molybdenum and so on, new properties have been bestowed. Demand for these steels reached a new record total in 1945.

Still another such development is the high temperature alloys—steels and alloys into which many and diverse alloying elements have been incorporated. These have resulted largely from war research in which the War Metallurgy Committee was a potent factor. They made possible some of the most striking achievements in war material.

One should also not forget the National Emergency or NE steels which were developed by American metallurgists early in this last war to conserve the then limited resources in nickel, chromium, molybdenum, etc. These are similar to the low alloy high tensile steels, also a product of the early part of this century. Both of these materials have been and are of inestimable value to designing engineers.

This brief review could be extended considerably so as to include the many diversified and interesting alloys of aluminum, of magnesium, and also of beryllium. Enough have, however, been cited to fully emphasize the role which alloying has played and is playing in developing new engineering materials. Many of our war and other achievements would not have been possible without this method of production.

Judged by the history of the last 40 to 45 years, new and still better materials may be expected from alloying. —E. F. C.

Thoughts on Industrial Research

It is refreshing at times to absorb the thoughts and line of reasoning of groups in foreign countries, related to those in this country. Certain philosophies and modus operandi regarding industrial research put forward at a recent Canadian convention were expressed interestingly in *Canadian Metals & Metallurgical Industries* for July. The article condenses some of the speeches on industrial research.

"Modern industrial research is not a haphazard affair. It begins with an attitude of mind," stated one of the speakers, philosophically-minded. "It then becomes orderly investigation, carefully organized and conducted in a straightforward business-like manner. Its natural form is the research project and each project must have a clear-cut scientific objective.

"Very often it is difficult to get a business man pinned down on an exact objective of the project he wants to have undertaken. Yet this is so important that research men consider the job well started when the problem and its objective can be outlined in a well-defined manner. Whether the investigation is to last three months or three years, it can be kept on the track if the objective is clearly understood."

After pointing out that a staff may consist of chemists, physicists, metallurgists and biologists, the speaker stated: "One of the interesting things about a research staff is the manner in which problems are sometimes solved by a casual combination of minds, although only one mind may be specifically assigned to a given project."

In short, there is a certain harmony throughout the universe so that a biologist, for instance, might well stumble upon the solution of a metallurgical problem—at least, he might well contribute to that solution with some pertinent idea. Many a problem has been solved at a "bull session" that may have started informally.

Another interesting truth was expounded by the Canadians: "No investigation of any importance begins without consulting the library, so that no time will be lost in retracing ground already covered in the past by others."

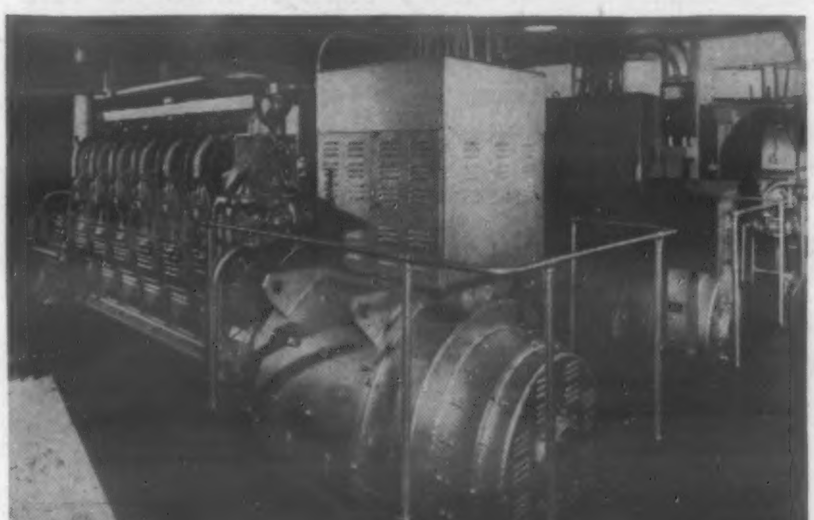
Speaking along another line: "This matter of making research available to smaller industrial concerns is one that is engaging many minds. . . . In the U. S., cooperative research is not widespread but there are a number of group projects successfully conducted. There several form a sort of syndicate, sharing cost and results. The outstanding example is the Institute of Paper Chemistry at Appleton, Wis., supported by 100 members."

A final interesting thought is that through research and development Canada should become world-supreme in one or more products, such as the Swiss in watches, the Irish in linens, Sheffield in cutlery [and the U. S. in automobiles?—Editor]. —H. A. K.

INLAND Ore Freighter First With Diesel-Electric Power

Reconverted and streamlined, with new power, new steering system, new hatch arrangement, increased capacity and a multitude of other improvements, the E. J. BLOCK, of the Inland fleet, recently made her first cargo run, with complete success.

The first lake ore-carrier to be driven by diesel-electric power, the vessel has many revolutionary features, such as hydro-electric steering, direct control of the engines from the bridge, permanent radar installation and new ballast pumps of greatly increased capacity.



Power plant of the E. J. Block consisting of two 1200 horsepower diesels driving electric generators. Either one is capable of propelling the ship.

The changes in this ship, made by American Ship Building Company, make this a most efficient carrier of raw materials for Inland Steel. With the new power system the E. J. BLOCK is one of the fastest vessels of its type. Either of its two main engines is capable of driving the ship under full load. The new steering system, direct engine-control, and radar installations make for a safer vessel. The improved pumps allow ballast to be expelled more rapidly, and in conjunction with the improved hatch arrangements, allow much faster loading of the 11,000 tons of ore, limestone or other materials.

This advancement in raw material transportation is a part of the Inland program of modernization and expansion . . . a program which will continue to supply more and better steel for American industry.

INLAND STEEL

INLAND STEEL COMPANY, 38 South Dearborn Street, Chicago 3, Illinois. Sales Offices: Detroit, Indianapolis, Kansas City, Milwaukee, New York, St. Paul, St. Louis

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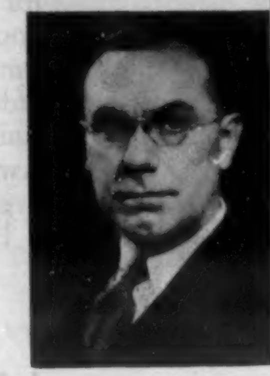
MATERIALS & METHODS

NOVEMBER 1946

The Judges

BASCH



BOSTON

JOHNSON

McCARROLL

PARKER

WILKINS

WILLIAMS

Announcement of

The 1946 Materials & Methods Achievement Award Winners

Early this year Reinhold Publishing Corp. announced the establishment of an annual MATERIALS & METHODS Award for outstanding engineering achievement in the metal-working industries. The basic purpose of the Award is to foster and encourage skillful and enlightened application of modern engineering materials and of methods for processing them. Companies, departments of companies, and individuals are eligible candidates, and all were represented in the entries received this year.

The 1946 Achievement Award is being made specifically for "the greatest achievement in applying war-born knowledge of materials and their processing to the manufacture of peacetime products." This year's award thus honors simultaneously the outstanding developments of the war period and their peacetime applications. Virtually every one of the large number of entries received in the 1946 competition, which was officially closed on July 30th, adhered to this "peacetime use of war-developed ideas" theme, and the Judges as well as the Editors have pronounced the first holding of this annual Award an unqualified success.

The Panel of Judges for the 1946 MATERIALS & METHODS Achievement Award was an exceptionally distinguished group, comprising:

David Basch, Representative for Canada and the U. S. A. of Almin Ltd. (Britain) Schenectady, N. Y.

O. W. Boston, Chairman, Dept. of Metal Processing, University of Michigan

J. B. Johnson, Chief, Materials Laboratory, ATSC, Wright Field, Dayton, Ohio

R. H. McCarroll, Director of Chem. and Met. Engineering and Research, Ford Motor Company, Dearborn, Mich.

Charles M. Parker, Secretary, Committee on Manufacturing Problems, American Iron & Steel Institute, New York, N. Y.

R. A. Wilkins, Vice President, Revere Copper & Brass Inc., Rome, N. Y.

Clyde Williams, Director, Battelle Memorial Institute, Columbus, Ohio

In studying the achievements entered in this competition, these men gave generously and cheerfully of their time, and the editors and publishers of MATERIALS & METHODS are deeply grateful to them. The Award decision was entirely in their hands; neither the Secretary of the Award Committee nor any of the other editors of this magazine had any part in or influence on the voting for the winners.

The achievements considered by the Judges included applications of all important types of engineering materials—ferrous, nonferrous and nonmetallic—as well as most of the major metal-processing methods. All of this—the caliber of the Judges plus the broad field of entries—brings added lustre to the winners of the Awards.

The Award Winners

The Judges have selected six recipients of Awards for outstanding achievement in applying war-born knowledge of materials and their processing to peacetime production—(a) one *First Award,* to the candidate receiving the highest number of votes in the Judges' balloting, and (b) five *Honorable Mention* Awards, to the five candidates receiving the next five highest scores in the voting.

In addition, the editors of MATERIALS & METHODS have chosen from among the remainder of the candidates 11 achievements which were particularly valuable or interesting and which we believe are worthy of special citation even though they failed to win top awards. These have been granted (c) *Editorial Citations* on the basis of their practical value or probable general interest in our field.

The Award Winners are as follows:

FIRST AWARD

J. O. ALMEN, Head, Mechanical Engineering Dept. 1, Research Laboratories Div., General Motors Corp., Detroit

For the study of pre-stressing (especially shot peening) of metals and the application of this knowledge to the improved design and longer service life of metal parts and structures for war and postwar use.

HONORABLE MENTION AWARDS

JACK & HEINTZ PRECISION INDUSTRIES, INC., Cleveland

For the application of light metal die castings, developed extensively in wartime, to the peacetime production of automotive products.

HAYNES STELLITE CO., Unit of Union Carbide & Carbon Corp., Kokomo, Ind.

For the wartime development of high-temperature alloys and fabricating methods for them offering great potentialities for peacetime use.

MARTIN FLEISCHMANN, Metallurgical Engineer, Steel & Tube Division, Timken Roller Bearing Co., Canton, Ohio

For the development of Timken 16-25-6 alloy, used during the war in gas turbines and turbosuperchargers and now being applied in several high-temperature peacetime products.

SAPPHIRE PRODUCTS DIV., ELGIN NATIONAL WATCH CO., Elgin, Illinois

For the wartime development of sapphire fabrication methods, and the peacetime application of the material and these methods to gages, tools and parts.

SOLAR AIRCRAFT CO., San Diego, California

For the wartime development of the Sol-A-Die process for forming stainless steel and other metals, and its extension into peacetime production jobs.

EDITORIAL CITATIONS

The winners of the following Editorial Citations for achievements of a less spectacular but still exceptionally noteworthy or stimulating nature were chosen not by the Panel of Judges but by your editors after carefully studying the remaining entries. Many of the achievements receiving Editorial Citations were indeed given high ratings by the Judges for their general value, but others were chosen by us as a tribute to the ingenuity, progressiveness or soundness of the applications involved without regard to their broad importance.

These citations follow:

ALUMINUM COMPANY of AMERICA, Massena, N. Y.

For the rapid, production line 100% inspection of aluminum alloy blooms for internal defects, using the Supersonic Reflectoscope.

MYRON J. BESTERVELT, Induction Hardening Supervisor, and
WILLIAM BLANCHARD, Processing Department, Continental Motors Corporation, Muskegon, Mich.

For the application of induction brazing-and-hardening (in one operation) and of metal spinning to the simplified, lowered-cost production of a governor sub-assembly.

BUICK DIVISION, General Motors Corporation, Flint, Mich.

For the application of Precisionaire airgaging equipment developed originally for inspecting gun barrels, to the mass-production inspection of auto engine cylinder bores.

ELLIOTT COMPANY, Jeannette, Pa.

For improvement in the design and construction of marine gas turbine plants now finding peacetime uses, through the skillful application of both old and new high temperature alloys.

JOHNSON MOTORS COMPANY, Waukegan, Ill.

For the development of methods of producing sound and strong aluminum alloy die castings and their application in the completely redesigned postwar marine motors made by this company as well as in the peacetime production of other manufacturers.

KEARNEY & TRECKER CORP., Metal Cutting Research Dept., Milwaukee, Wis.

For the development of fundamental information on high-speed metal cutting with carbide tools and the wide dissemination of this knowledge to aid both war and peacetime production.

LANDIS TOOL CO., Waynesboro, Pa.

For the wartime development of a method and equipment for centerless grinding of threads, now being applied to several peacetime products.

NORTH AMERICAN AVIATION, INC., Los Angeles, Calif.

For the application of Fiberglas-reinforced plastics in aircraft parts previously made of metal.

VISKING CORP., Plastics Dept., Chicago, Ill.

For the use of a new synthetic plastic polymer (polyethylene) in producing sheeting and tubing for protective packaging of war equipment and subsequently for a host of peacetime industrial products.

WILLIAM WERME, General Superintendent, Worcester Pressed Steel Co., Worcester, Mass.

For the successful application of a sheet metal forming technique, developed originally for brass howitzer cases, to the production of cold-formed brass cases for maritime clocks and instruments.

WARREN McARTHUR CORP., New York, N. Y.

For the application of magnesium alloys, of improved methods of arc welding magnesium, and of new tube-bending techniques, in the construction of light weight and highly comfortable aircraft seating.

Also worthy of receiving Editorial Citations but previously described in some detail in these pages are (1) Crosley Motors, Inc.'s use of brazed stampings as the basis for an exceptionally light and powerful automobile engine (described in MATERIALS & METHODS for February 1946, p. 438), and (2) American Rolling Mill Company's development of aluminum-coated steel, now finding increasing use in peacetime products (described in MATERIALS & METHODS, July 1946, p. 90).

Concerning J. O. Almen

J. O. Almen, winner of the highest honor in this, the first MATERIALS & METHODS Achievement Award, is generally recognized as one of the ablest engineers in the metal product design and production field in this country today. While most of his recent work has been directed to products made by the automotive industry, that industry has recently completed five years of manufacturing everything from airplane engines to zinc alloy die castings; Almen's ideas and data have been spread over the whole automotive industry and then beyond it, via his wartime N.D.R.C. and O.S.R.D. contributions, his S.A.E., A.S.M.E. and A.S.T.M. committee work and his technical publications, into practically all important phases of metalworking and metal product manufacture. The *breadth* of the influence of Almen's work throughout all the metalworking industries was undoubtedly a leading factor in the Judges' decision.

The achievement for which Mr. Almen receives our First Award this year, centering around the prestressing of metals, is described in the First Award report in this issue, starting on the next page. We commend the article to our readers as a concise report of that wartime materials-and-processing development which our Judges considered most important from the standpoint of its broad and profound effects on peacetime product manufacture.

The editors and publishers of this magazine, together with our Panel of Judges, join in congratulating Mr. Almen on winning the First Award in the first MATERIALS & METHODS Achievement Award Competition. All honor, too, to the winners of the "Honorable Mention" Awards and to the recipients of "Editorial Citations." The stories of their individual achievements follow the report on Mr. Almen's work, the record of these leading achievements comprising the entire feature section of this issue of MATERIALS & METHODS.

Mr. Almen will receive a plaque, and the five winners of "Honorable Mention" Awards framed certificates, at a special presentation dinner to be given at the Hotel Claridge in Atlantic City, Wednesday, November 20th, during the National Metal Congress and Exposition.

Details of the 1947 MATERIALS & METHODS Achievement Award will be announced in the January 1947 issue of this magazine. Your editors wish to do everything possible to make next year's Award as great a success and as substantial a contribution to improved product quality and production efficiency throughout the metalworking industries as was the 1946 competition. To that end we invite the comments, criticisms and suggestions of our readers, and we assure you they will receive our most careful attention.

FRED P. PETERS, Secretary, Award Committee, and Editor-in-Chief, MATERIALS & METHODS

First AWARD TO J. O. ALMEN,

Head, Mechanical Eng. Dept. 1,

Research Laboratories Div.,

General Motors Corp.

For Achievement In

Pre-Stressing of Metals and Metal Parts

The cold working of metals to improve their strength and durability is as old as metalworking itself. Only in recent years, however, has attention been concentrated on special surface stressing processes, such as shot peening, applied primarily to improve the fatigue life or endurance limit of metal parts, and on the effects of adventitiously produced surface stresses on the performance of metal products.

During the war years J. O. Almen and his associates at General Motors did outstanding and brilliant work in analyzing the causes of service failures of metal parts, in disseminating knowledge concerning them and in promoting the intelligent use of surface stressing procedures to lengthen the fatigue life of a host of war products. Because of these activities numerous other plants and engineers followed their lead and the result has been universally hailed as an important contribution to Victory.

Many of the data thus collected and published, and others (*e.g.* in N.D.R.C. reports not yet released) are now being applied to peacetime products. Typical fatigue life improvements that have been reported by Almen are 450% for steering knuckles, 900% for engine crankshafts, 1370% for helical springs, 600% for hypoid gears, etc.—all through the application of shot peening to pre-stress the surface. Others (*e.g.* H. F. Moore, Fischbeck & Schmitt, Zimmerli, Horger, Lessells & Murray, etc.) have reported similar life improvements in a variety of products through use of these principles and processes.

Surface Stressing

A large proportion of mechanical failures of metal parts are fatigue failures, which propagate from a surface crack under the influence of dynamic loading, often at relatively low average stresses. Almen has boiled this down to this concept: "Fatigue failures result only from tension stresses; never from compressive stresses; and any surface, no matter how smoothly finished, is a stress raiser."

The surface stressing of metals by cold peening them (and by certain other means) places the surface in compressive stress and, in effect, gives it a "head

Specific Nature of Achievement: **The study of pre-stressing (especially shot peening) of metals and the application of this new-found knowledge to the improved design and longer service-life of metal parts and structures for war and postwar products.**

One of the earliest shot peening applications was to leaf springs, where improvements of several hundred percent in fatigue life were effected. (Courtesy: American Foundry Equipment Co.)

start" in opposing the potentially damaging effect of locally applied or developed tensile stresses. However carefully a machine part (or a test specimen) is prepared, its fatigue strength will be increased if it is prestressed in compression by peening with shot, hammers, balls, rollers or by tumbling or swaging. The accompanying bar chart, taken from a paper by Almen in *S.A.E. Journal,* shows the increased fatigue life resulting from shot peening some typical machine parts.

The most common method of surface stressing is shot peening or shot blasting, in which a stream of metal shot (either chilled iron or heat treated steel) is thrown from a wheel or by air blast on to the surface of the part being treated. The machines and equipment used for shot peening are well engineered and subject to control as to intensity of bombardment.

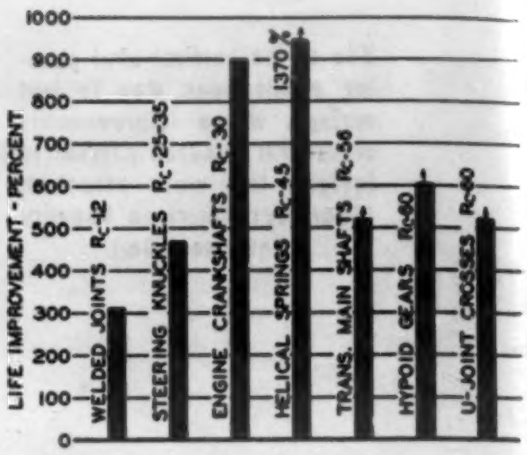
This control is necessary because a surface can be *overstressed.* Almen reports several instances in which the strength of machine parts has been decreased by too intense surface peening. A schematic view of the effect of overstressing is given in the accompanying curve, which shows how the fatigue strength of a part will increase with increasing intensity up to a maximum, after which continuing increase in intensity will reduce the fatigue strength and may ultimately damage the part. The exact amount of surface compressive stress that will confer optimum fatigue properties varies with the material, shape, section thickness and hardness of the part, and must usually be determined by experience plus trial-and-error.

However, it is now possible to control the intensity of shot peening and thereby the uniformity of depth and stressing of the compressed layer by the use of the so-called Almen Intensity Gage, developed by J. O. Almen. This consists of a standard-size thin flat steel strip of 44 to 50 Rockwell C hardness, which is clamped firmly to a heavy base and then peened with shot or rolls or hammers at the intensity to be measured. On removal from the base, the strip will be curved (owing to the different stress conditions at its surface and in its interior) with the cold-worked side convex. The height of the arc may be measured by an indicator and serves as a convenient index of the depth of surface stressing and, therefore, of the peening intensity. The use of the Almen gage is now widespread and is generally credited with having opened hundreds of worthwhile applications to shot peening, because of the possibility of close control it introduced.

Good and Bad Stress Effects

An enormous amount of useful data on the good and bad effects of surface stresses and on the practical utility of different metal-processing operations from the fatigue standpoint have resulted from Almen's work, and many have been published. Thus nitriding,

Rocker arms, with protective rubber masks in place, about to enter a specially designed shot peening cabinet. (Courtesy: Pangborn Corporation.)



Some typical percentages and improvements in fatigue-life produced by shot peening. (From an article by Almen in S.A.E. Journal.)

rapid quenching, carburizing, hardening, and other treatments are now known to be decidedly beneficial under certain conditions, and harmful in others.

The beneficial effects of compressive surface stresses are enjoyed in conjunction with the compensating residual internal tensile stresses. If the latter become excessive (*e.g.* because of over-compressing the surface) fatigue failures originating below the surface may be induced and the part may have a fatigue-life only a fraction of that had it been untreated.

For this reason, although nitriding is generally beneficial and usually superior to simple cladding in improving fatigue properties, care must be used in nitriding thin sections to gage the depth of the nitrided layer in proportion to the total thickness of the section being treated.

Carburizing-and-hardening leaves the surface of a steel part in compression, and thus improves its fatigue properties. But a carburized, hardened *and ground* surface may end up stressed in tension, and such parts as bearing races, wrist pins and gear teeth may have inferior fatigue properties if left in this condition. A simple remedy, again, is to peen the surface, converting the surface tensile stresses to compressive stresses and improving the service characteristics of the part. Similarly, thin-layer residual tensile stresses are also likely to result from induction hardening and flame hardening, and should be corrected if suspected by peening before being placed in service.

General Design and Production Benefits

This new knowledge of the effects of surface compressive stresses and internal tensile stresses, and of the means by which such stresses are produced and balanced, has had a profound effect on the design and process-planning of metal parts. The "hard case and ductile core" concept of earlier days is being replaced with one calling for high hardness—even approaching "brittleness"—where fatigue properties are the controlling properties, as they most often are in machine parts.

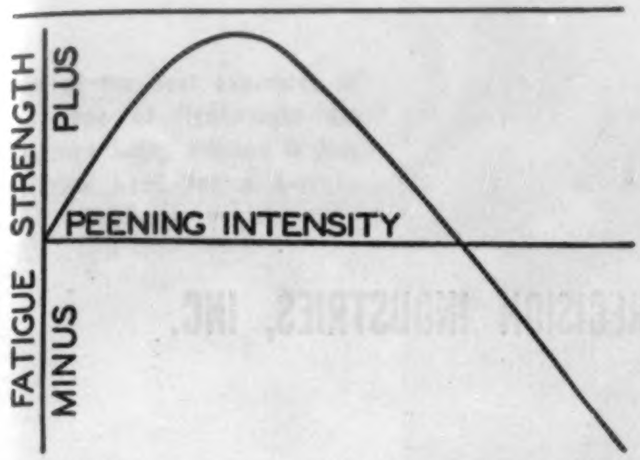
Improving a fillet form or finish may be insufficient to eliminate fatigue failures if the surfaces are inadequately pre-stressed in compression. Corrosion fatigue may be reduced by peening even though corrosion itself proceeds apace. Machine polishing and grinding may introduce high surface tension stresses; this is no condemnation of these useful, often essential operations, but a suggestion that their obvious utility would be improved by subsequent peening.

Almen's contributions to gear design are too extensive to enumerate here, and the application of the concepts he formulated to crankshafts, connecting rods and other steel parts has had wide influence on the quality of machine and engine parts in a dozen industrial fields. And from them, too, many engineers have been able more efficiently to utilize the production benefits of polishing, grinding, nitriding, carburizing, surface hardening, honing, electroplating, low-temperature treatments, etc.

Surface stressing processes have been set up in many plants during the war and are being continued, and even extended, in peacetime production. The plants using these developments are too numerous to list, but they include Ford, Chrysler, Packard, several General Motors plants, Studebaker, Pratt & Whitney Aircraft, Wright Aeronautical, and a host of other companies, large and small, in this country and abroad. The parts treated include gears of all types, splines, crankshafts, rocker arms, springs, connecting rods, welded joints, and many others.

For example, the practice and advantages of shot peening as used by Pratt & Whitney Aircraft were described in an article by Fischbeck & Schmitt in the October, 1945, issue of this magazine. Shot peening has become standard practice at P & WA on certain rocker arms, aluminum pistons, valve spring washers, articulated (or link) rods, around holes and counterweight cheeks on crankshafts, and on many gears including the high and low ratio clutch oil vent gears. The improvements in fatigue strength and service performance have been considerable.

P & WA engineers claim other than the conventional advantages from peening. The surfaces hold lubricating oil better than unpeened parts, which also applies to parts that have been given a black oxide finish after peening. The peening operation in some



Increasing intensity of shot peening increases fatigue strength up to a certain point, after which a reduction in fatigue properties occurs. (From an article by Almen in S.A.E. Journal.)

cases, whenever it is necessary to break sharp edges, follows tumbling. Link rods and pistons, however, are not tumbled. Both ferrous and nonferrous metals are shot peened.

The Ford Motor Co. has made extensive use of shot peening in their manufacturing operations, applying this method of surface stressing to ring gears and pinions for trucks. According to their tests the fatigue life of unpeened gears was 125,000 pinion revolutions, at a torque load of 78,400 in.-lb.; this fatigue life figure was more than doubled by shot peening. When gears finally do fail in the tests, failure is not at the roots of the teeth but through crumbling of the tooth flanks. At the Ford company one machine is able to shot peen 900 sets of ring gears and pinions per 24-hr. day.

Shot peening and other pre-stressing methods have advantages that are corollary to the obvious one of strengthening the parts so treated or extending their service life. One of the most important of these is that controlled pre-stressing of parts enables them to be designed in smaller sections or to be made of less costly materials—the basic change being a reduction in the factor of safety applied by the design engineer. This is extremely important in the design of all types of machines embodying low weight and high stress, such as automotive equipment and aircraft. Obviously the dynamically loaded parts of such machines should be designed with accurate knowledge of their fatigue strength—the sort of knowledge that Almen has been accumulating and applying for the past several years.

Indeed, the educational effect of Almen's work has gone far beyond its application to the improvement of metal-part quality by pre-stressing. He has made engineers reappraise broadly their general dependence on such things as ductility, the impact test, and yield strength as the basic factors in materials engineering design. He has made many of us think of product manufacture as a procession of closely interrelated operations, the whole to be planned as an integrated job, rather than as a series of separate steps.

And he has made us realize that we still are ignorant of the properties, performance characteristics and potentialities of the materials and processes that are the backbone of our industrial society.

J. O. ALMEN, winner of the First Award in the 1946 MATERIALS & METHODS Achievement Award competition for his work on pre-stressing of metals, received his engineering training at Washington State College, Pullman, Wash., in the Class of 1911. He spent a number of years in various engineering jobs on the Pacific Coast, the principal one being the development of barrel-type engines in cooperation with the Army Air Corps at McCook Field.

Since 1926 he has been employed by the General Motors Research Laboratories as Head, Mechanical Engineering Department 1. During this period he has been active in automobile engineering problems ranging from bodies to suspension systems and from engines to rear axles, with particular emphasis on transmission and rear axle gears. A similar range of subjects is covered by patents, approximately 75 in number, that have been issued to Mr. Almen.

Among the innovations that have been fostered by Mr. Almen are resonance intake and exhaust silencers now in universal use, automatic valve adjusters used by several automobiles, automatic transmissions and automatic transmission controls (Hydra-Matic), and plate spring clutches used by several makes of automobiles.

Mr. Almen was a pioneer in the development of extreme pressure lubricants, and designed several machines that are being used for testing gear lubricants and engine bearings.

During the late war Mr. Almen devoted most of his time to strength-of-materials problems under the auspices of the National Defense Research Council. This work consisted in giving aid to any manufacturer of war material in overcoming service failures by processes that did not require the loss of time or interchangeability that would have occurred if the trouble were overcome by redesigning and re-tooling. It was in this particular field that Mr. Almen's advocacy of shot peening and his investigations on pre-stressing generally were so influential, not only in speeding victory but also subsequently in improving the design and production of many postwar products.

Honorable Mention TO **JACK & HEINTZ PRECISION INDUSTRIES, INC.**

For Achievement In

Use of Light Metal Die Castings

The Jack & Heintz company has made a notable contribution, not only to automotive design but also to the development of the postwar light metal and die casting industries, in its thoroughgoing use of light metal die castings wherever possible in its peacetime products. The use of die casting as a fabricating process was a major feature of Jack & Heintz's outstanding war production record, and the company's success with it as applied to aluminum and magnesium has led them to use it as the process base for all future product designs.

The company entered the aircraft accessory business in 1940, and evolved a starter that was immediately ordered in large quantities. At first the design incorporated magnesium sand castings, but it was quickly determined that all of the magnesium sand casting facilities in Cleveland, if turned over to J&H starters, would not take care of future needs. The chief bottleneck was the main body casting which looked at first too complicated to die cast, as it required angular draws, casting-in of steel inserts, and other burdens on the die maker and die caster.

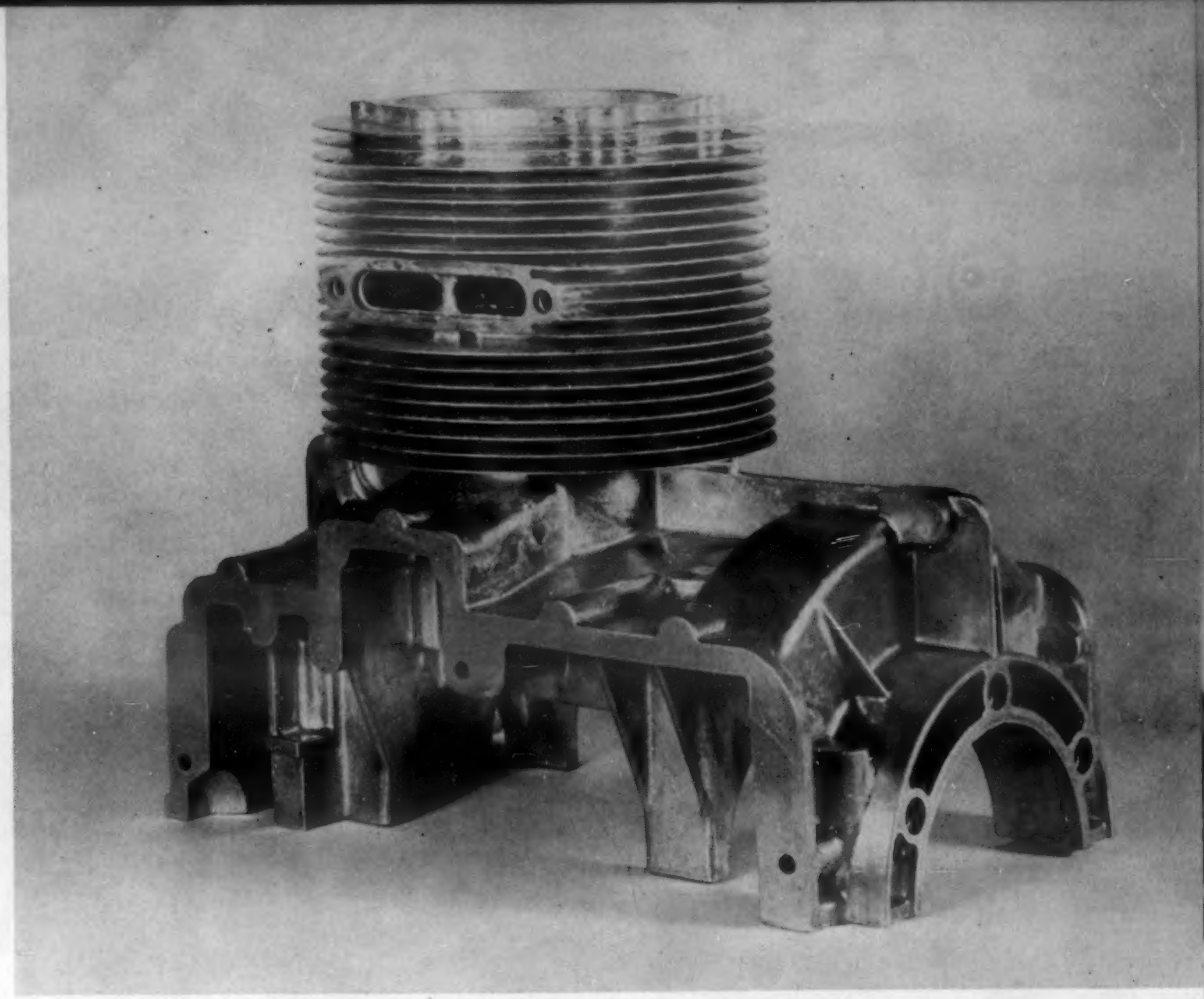
However, dies were designed and although some difficulty was encountered, within a surprisingly short time they were getting sound castings having very thin sections, and instead of receiving the 25 or so sand castings a day that the foundries could have supplied, deliveries were at the rate of 50 die castings per hr.

They immediately redesigned their motor shell and flywheel cover so that they, too, could be die cast. While the cost of the dies seemed very high at the time, once production was instituted the high die costs were quickly written off and the company was encouraged to immediately go to die casting two other products. Eventually not a single sand casting was used in any of their products, even in such relatively unimportant pieces as starter hand cranks.

At the end of the war, Jack & Heintz had 780 odd dies and had used something over 20 million die castings, made by 15 suppliers. Some of the castings were intricate and ordinarily considered beyond the reach of die casting technique; some were tiny and some were of considerable size.

As the war approached its end, Jack & Heintz began planning and then producing the peacetime embodiment of these lessons—the largest and most complicated die casting they had made so far (and probably the largest complex die casting ever made). This was a die cast cylinder block for an air-cooled,

Specific Nature of Achievement: **The application of light metal die castings, developed extensively in the manufacture of wartime aircraft accessories, in the production of automobile engines and other automotive parts with impressive improvements in cost and in engine power-per-pound.**



One of the best examples of the type of lightweight die castings being utilized is this cylinder head for a 4-cycle, 2-cylinder engine.

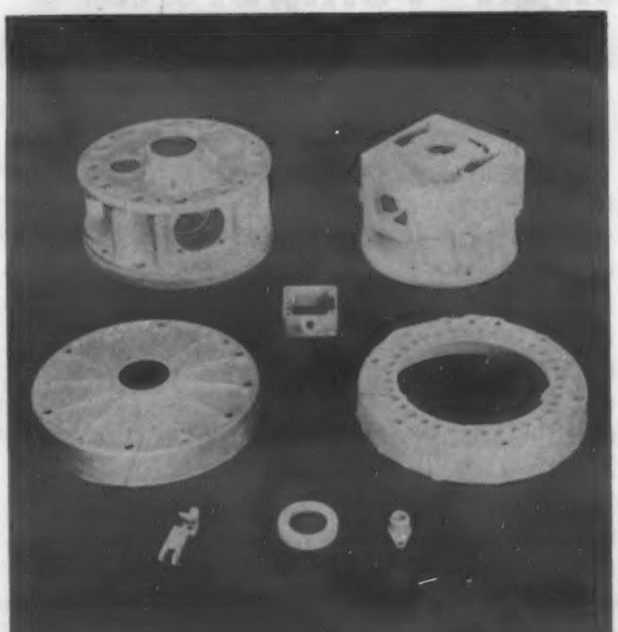
4-cycle high performance 2-cylinder engine. The largest die casting machine in this country, weighing 75 tons, was built and operated by Westfield Mfg. Co. to make this piece, the dies for it weighing 14,000 lb.

Now in the trial-production stage is a 6-cylinder engine, the outstanding feature of which is the complete cylinder head and crank case assembly, which comprises just two die castings—in other words, each casting is ½ of the 6-cylinder motor block. The die block for this casting weighs 16 tons, and will include all the features developed on the previous 2-cylinder job.

Several other parts of this engine—cylinder head, oil pan, accessory cover, front and rear covers, main bearing block, valve supports, carburetor castings, fuel pump castings, etc.—are light metal die castings, and because of this these automotive motors approach normal expectations for airplane motors in their weight-horsepower ratio (about 1.2 lb. per hp.).

While approximately 65% of the die cast pieces were made of magnesium, high strength aluminum alloys (especially alloy No. 218) have also been advantageously employed. With the advent of the new cerium-bearing magnesium alloys, which have such good elevated temperature properties, consideration is being given to the production of automotive and aircraft engines with an even higher proportion of light metals in their make-up.

This company believes strongly that the war's experience has shown magnesium and aluminum together with the special low-cost fabricating methods peculiarly suited to them (*e.g.,* die casting) to be the answer to the cost problems facing most manufacturers today and in the future.



Here are a group of aluminum and magnesium die castings used by Jack & Heintz. Included are flanges, housing, case and support for a starter assembly.

Honorable Mention TO **HAYNES STELLITE CO.,**

Unit of Union Carbide & Carbon Corp.

For Achievement In

High Temperature Alloys

The development of the "super-alloys" for high-temperature use was peculiarly a development of the war period and involved many companies and institutions in addition to Haynes Stellite. For example, most of the test work on the Stellite alloys was done under NDRC contract at Battelle, under the direction of Howard C. Cross. Haynes Stellite made alloys, as did other companies, for such manufacturers as General Electric, Westinghouse, Allis-Chalmers, and these latter companies made their alloys, too.

The special feature of Haynes Stellite's contribution was the development of alloys (Stellite 21 or "Vitallium" and "Hastelloy B") to resist the very hottest temperatures reached in turbosupercharger and gas turbine service, alloys that often had to withstand temperatures higher than 1500 F, of special all-round alloys with somewhat lower heat resistance but with better fabricating properties (N-153 and N-155, or "Multimet") and of methods for casting or forging these to reduce their manufacture to a mass-production basis.

During the war the precision ("lost-wax") casting process was developed to a mass-production level by Haynes and applied to the manufacture of turbine blades of Stellite 21 (or Vitallium, an alloy originally developed for Austenal Laboratories by Haynes Stellite) turbo blades. At the peak of production (April 1944), the Haynes precision casting plant produced 2 million buckets that month and the total war output was at least 25,000,000; this material was virtually the only alloy used for most of the turbo-supercharger buckets or blades made during the war.

The cast Stellite 21 buckets were welded to forged wheels made of forged Timken 16-25-6 alloy. The assembly performed admirably, the hotter temperatures being reached, of course, at the buckets.

Specific Nature of Achievement: **The development of high temperature alloys, and of methods of fabricating them, which represented a major contribution to Victory in World War II and which offer great potentialities for peacetime use.**

The development of gas-propelled aircraft and the widespread use of turbo-superchargers made urgent the development of superalloys.

The peacetime applications for these Haynes Stellite super-alloys are developing fast, and the materials are proving as great a boon to postwar engineering as they were to the war effort. Many companies are now investigating the gas turbine field, and Haynes are now making precision castings for virtually every company in the country producing any form of gas engine. Some of the designs are exceedingly radical, including many hollow buckets. The turbines are for aircraft, marine, locomotive and stationary power uses.

Other outstanding applications of these war-developed alloys are in steam turbines, aircraft exhaust stacks, tail cones, combustion chamber liners, high temperature bolting, etc.

Several engineers and war leaders have hailed the superalloy program and the high-temperature alloys as a whole as the outstanding engineering materials development of the war. Many have referred to Haynes as the most prominent manufacturing factor in this program (certainly they made most buckets) and as having produced the most heat-resistant of the materials commercially used and as having developed the group of alloys with greatest peacetime possibilities.

Many of the high temperature alloys developed during the war and fabricated by Haynes-Stellite were used in buckets for gas turbines and blades in superchargers.

Honorable Mention TO **MARTIN FLEISCHMANN,**

Metallurgical Engineer,

Steel & Tube Div.

Timken Roller Bearing Co.

For Achievement In

Heat Resistant Alloys

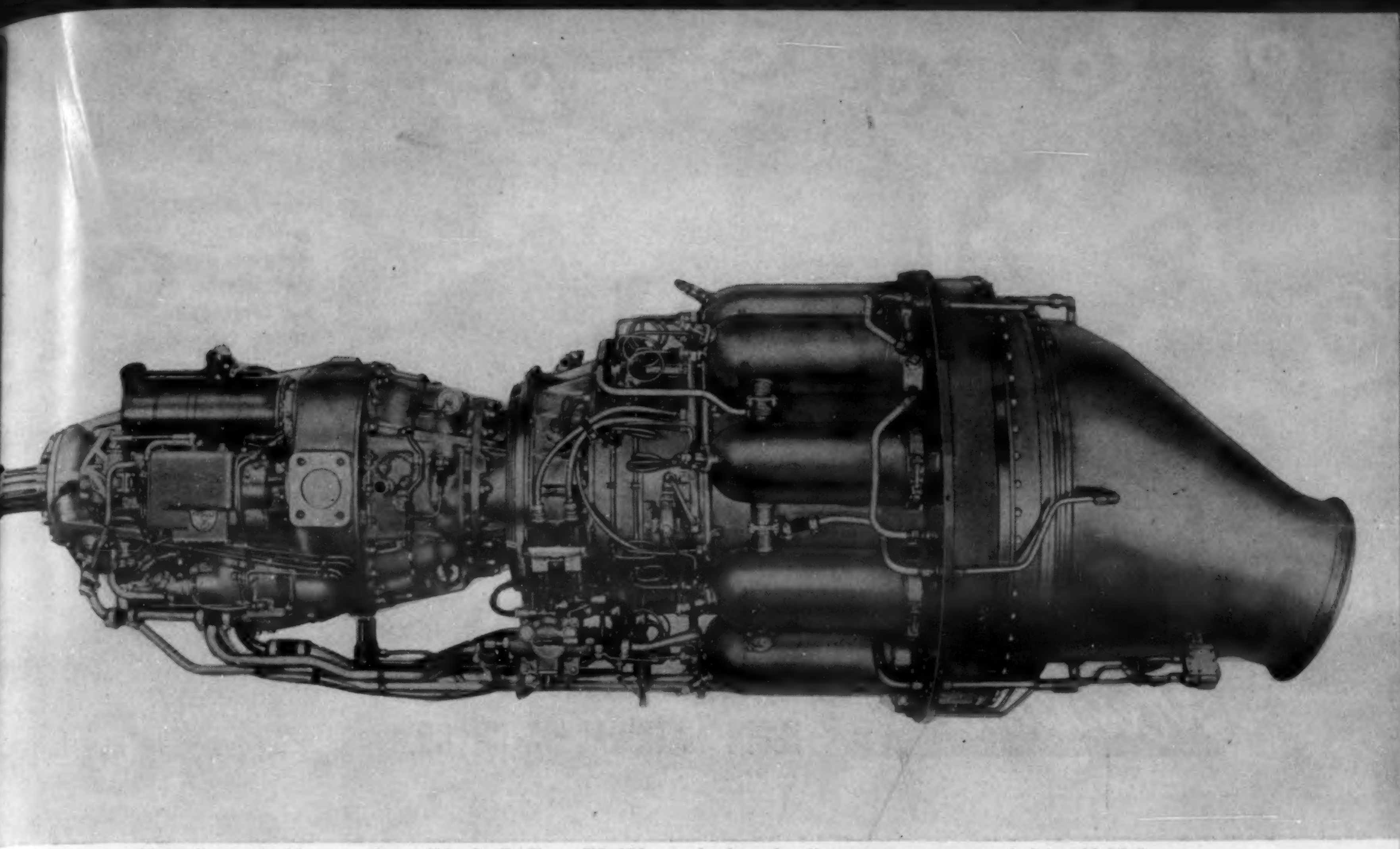
The construction of efficient airplane turbosuperchargers became a critical necessity early in the war, and was achieved in time to wreak havoc on our enemies through the development of heat resistant alloys that would permit operation at 1500 F and, therefore, reasonably long life and high thermal efficiency. The same materials were, of course, applied in gas turbines.

One of the first of these new superalloys to be so applied, and in the opinion of many the most important because of its all-round combination of high-temperature behavior, workability and reasonable cost, was the Timken 16-25-6 alloy developed by Mr. Fleischmann and his associates. During the war years more than 12 million lb. of the alloy were shipped in forms ranging from ingots to be forged into large gas turbine wheels down to flat stock and bars for turbine blade applications. Hundreds of thousands of General Electric turbosupercharger wheels were made from this alloy during the war, without the occurrence of failure of a single wheel.

All our Flying Fortresses, Liberators and high-altitude fighters depended on this alloy in turbosupercharger wheels for their power at high altitudes Shortly before the end of the war the same material found application in the turbine wheels of our jet planes and is still in production for the power plant of the P-80 Shooting Star and many other jet driven planes.

The postwar applications and possibilities of the 16-25-6 alloy are impressive. Today it is finding its place in turbine buckets and wheels for turbosuperchargers on Diesel engines where this device may step up the rated horsepower of a given engine approximately 50%. Indeed, the entire development of the gas turbine as a prime mover will demand this material in its highly stressed parts operating at temperatures up to 1500 F. The Allis-Chalmers gas

Specific Nature of Achievement: **For the development of Timken 16-25-6 alloy, a 16 chromium, 25 nickel, 6 molybdenum alloy used during the war for stressed parts of turbosuperchargers and gas turbines operating at temperatures up to 1500 F, and now being applied in several high-temperature peacetime products.**



Aircraft gas turbines such as this G. E. Type TG-100 required such alloys as are represented by 16-25-6.

turbine operating for the Navy Experimental Station at Annapolis has just completed its breakdown test with gas at 1450 F. The complete gas turbine rotor assembly, as well as the stationary blading, was produced from the Timken 16-25-6 alloy and is meeting all expectations. The development of gas turbines for ship propulsion, therefore, is brought to close realization.

Gas turbine locomotives using powdered coal as the fuel are in the final stage of design. The use of Timken 16-25-6 alloy may be the heart of this development, assuring thermal efficiencies far above our present locomotives, in fact approaching the Diesel but using coal instead of oil.

The use of the 16-25-6 alloy, however, has not been confined to gas turbine applications. Tests are in progress to use this material in dies, especially for die casting of brass and bronze where the best materials of today give only very limited life. They feel that the 16-25-6 alloy suitably work hardened and tempered may revolutionize the die casting industry. Spectacular results have already been obtained on limited specimens.

This war-born material, the 16-25-6 alloy, represents a significant contribution to the peace-time development of the metalworking industries.

Among the uses for 16-25-6 alloy are gas turbine disks and blading and supercharger parts. Here is a forged disk before machining and after machining and with blading attached.

Honorable Mention TO **SAPPHIRE PRODUCTS DIV., ELGIN NATIONAL WATCH CO.**

For Achievement In

Sapphire Tools, Gages and Parts

The production of sapphire and its large scale fabrication into industrial parts was a wartime development in this country. When the foreign supply of synthetic sapphire was cut off early in the war, a number of companies were commissioned to undertake the manufacture of sapphire jewel bearings. The Elgin plant was the largest to enter this field, and Linde Air Products Co. was the first and largest commercial American producer of sapphire as a raw material.

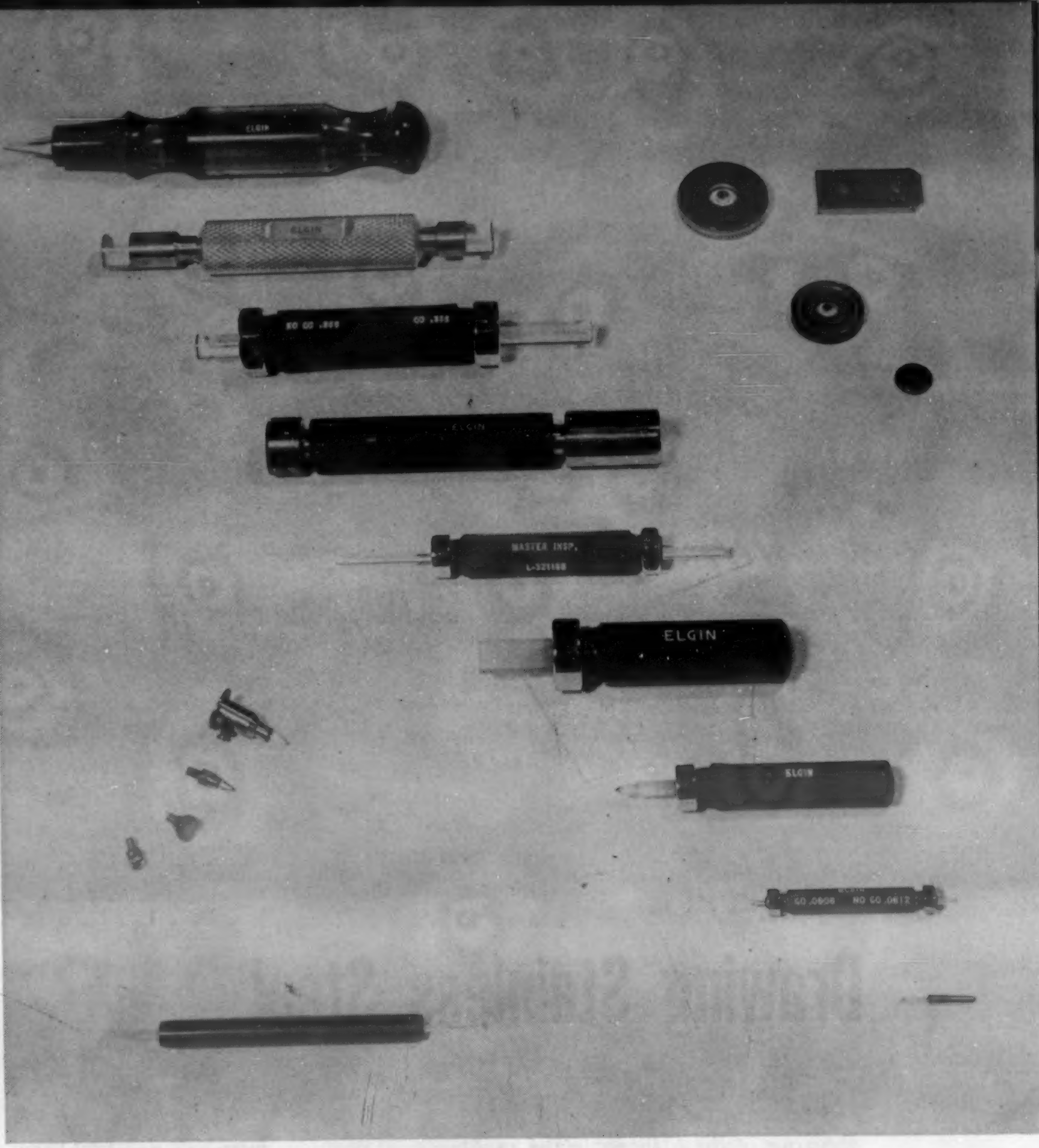
In less than 5 years a strong new sapphire producing and fabricating industry developed in this country and outstripped the progress of earlier foreign sources in the production shapes, qualities and materials. At the Elgin plant an astonishing production of jewel bearings was accompanied by research projects on the production and fabrication of sapphire, by a complete diamond-processing plant (diamond is the material used to fabricate sapphire) and by investigation of the properties and uses of sapphire as an engineering material.

Sapphire (Al_2O_3, and in the corundum family) is harder and purer than its cousins emery, abrasive alumina, etc., and is harder than tungsten carbide. It is less hard than boron carbide, but tougher. Indeed, synthetic sapphire has a combination of hardness and toughness superior to that of any other man-made material.

Until recently, virtually all industrial uses for sapphire were as jewel bearings in precision instruments,

Specific Nature of Achievement: **The wartime development on a large scale of sapphire fabrication methods and the application of the material and these methods in the peacetime production of gages, production tools and wear-resisting parts.**

Included among these sapphire tools are burnishing tools, plug gages, slot gage, needle gage pivots, ring gages and comparator and dial gage contact points.



where the material's high compressive strength and low coefficient of friction against metals make it outstandingly advantageous. In the last two or three years, and most intensively since the war's end, Elgin has developed applications of sapphire for burnish-cutting tools to be used on soft metals, for boring and turning tools on small parts, in dimensional control gages, and for a host of parts like ring gages, dial indicator points, comparator gage anvils, V-blocks, and so on.

The wartime experience with this relatively new engineering material has resulted in the production by Elgin of such sapphire parts as wear strips, machine parts, etc. at costs comparable to those for tungsten carbide and hard-chromium-plated parts. Beyond that, it is already being used for thread guides in the rayon industry and (because of its ability to transmit ultra-violet light better than any other material) in the ultra-violet treatment of blood plasma and serums. And promising results are evident in experiments on its use for pressure-vessel and compression-chamber windows, as precision-grinding-center tips and elsewhere.

This micro mortar and pestle set in which Elgin sapphire is used assures freedom from contamination and porosity.

Honorable Mention TO **SOLAR AIRCRAFT CO.**

For Achievement In

Drawing Stainless Steel

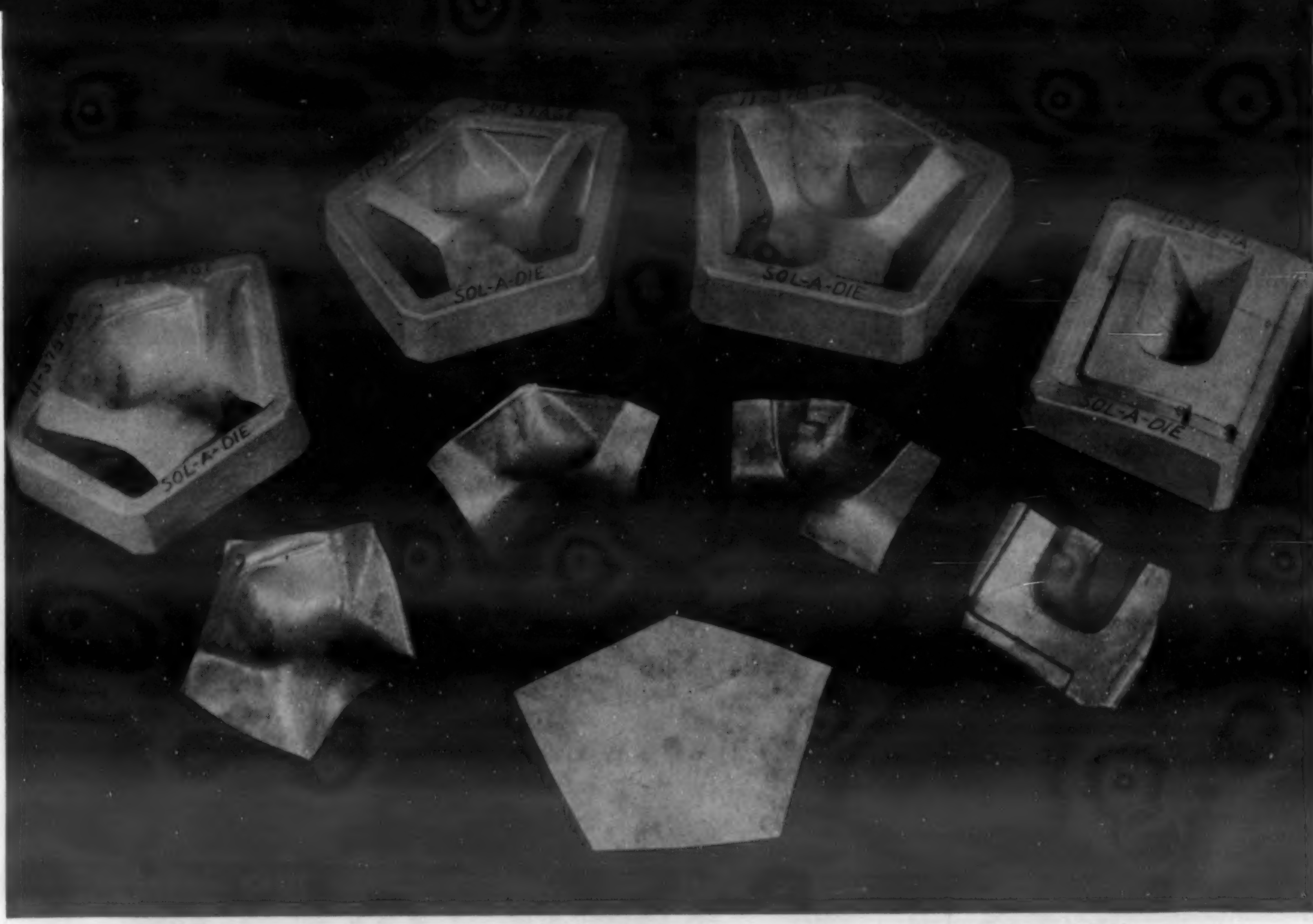
As one of the pioneers in the application of stainless steels to aircraft and in the mass production of stainless steel shapes, Solar Aircraft Co. long sought and finally developed a method by which deeper drawing can be accomplished without excessive or critical thinning of the metal. In many cases where this was previously impossible, parts can now be drawn that were formerly stamped in two or more pieces. The process has been widely applied to parts made of 18:8 stainless, aluminum alloy and alclad type materials.

Essentially the process, termed the "Sol-A-Die" process, is a simple, free-from-mathematics method of "staging" the metal drawing and shaping in such a manner as to reach the final absolute *area* of the desired form in the first stage (rather than the last) of a series of one to sometimes five forming stages. Successive stages after the first become largely a matter of metal folding rather than metal drawing.

The stage die patterns are produced by this process in less than half the time normally required, and in virtually every instance have produced successful, often complicated stampings without costly reworking. The process starts with the *final* die, which is coated with a water soluble slip coat, and then with liquid beeswax and cheesecloth in successive layers until a laminated sheet pattern of desired thickness is achieved. This is then allowed to cool and stiffen and is easily separated from the die.

This pattern sheet is flexible (but not stretchable nor shrinkable) and can be unfolded and flattened. As the next step in the process it is unfolded to the desired degree, and in the unfolded form becomes the matrix for the plastic pattern for the drawing stage preceding the final stage. Where more stages than this appear desirable, further unfolding is done

Specific Nature of Achievement: **The development and use of a stage-die process for forming stainless steel and other metals, which permits deeper drawing without excessive thinning of the material or makes possible the production in one piece of parts formerly manufactured as assemblies.**



Starting with the blank in the foreground, a shape is produced through the four stage dies shown. The final shape appears at the right.

and additional patterns are made and flattened to a greater degree, until all stages are thus completed. Even if there are vertical surfaces in the final part, the wax pattern can generally be opened to a point where the maximum slope is 20 deg.

The number of stages is determined more by the ability of the work to "nest" in the next later stage than by the deformability of the material. The fact that nearly all deformation is done by direct impact in the first relatively shallow stage and that subsequent forming is by *folding* eliminates most of the shearing and tearing usually associated with the production of parts having vertical or near-vertical sides.

The process was first conceived in 1939, and thereafter developed to its first successful production use in February 1943. To a recent date, the Sol-A-Die process has been used in producing the stage die patterns for 609 parts of some 60 different assemblies having a value of approximately $25,000,000.

It is impossible to present accurate figures as to what Solar and Solar customers have saved as a result of this process. However, investigation of specific cases has indicated the process has saved better than 50% of previous stage die design and production costs, and about 30% of total modeling department costs for staged parts. The savings reflected in total production costs of assemblies is estimated at from 10 to 15%. These large overall savings are made possible by having fewer inches of welding per assembly, because of the ability to form more complex shapes; the elimination of machine and hand peening operations; the use of thinner material; the elimination of intermediate annealing, and having fewer rejected stampings and welded assemblies as a result thereof. The close control of metal flow and nearly even distribution of metal permit use of a thinner gage metal while still maintaining specified net thickness.

Vibrational stresses of cantilevered parts are reduced by the weight saving made possible by this process. On large airplanes, for example, engine-mounted manifolds have been substituted for the heavier, more complicated and costly cowl-mounted manifolds; this, in turn, permits the use of a split-nose cowl and obviates removal of the propellers whenever it is necessary to work on the engine.

Beyond the airplane industry this low-cost staging die process materially aids in reducing tooling charges on low-volume jobs, for example, for custom automobile bodies and experimental designs. Such work has traditionally been exorbitantly expensive because of the high cost of conventional dies, on one hand, or of beating out the shapes by hand over a forming block.

EDITORIAL CITATION *to* KEARNEY & TRECKER CORP.

Metal Cutting Research Dept.

For Achievement In

Machining of Metals

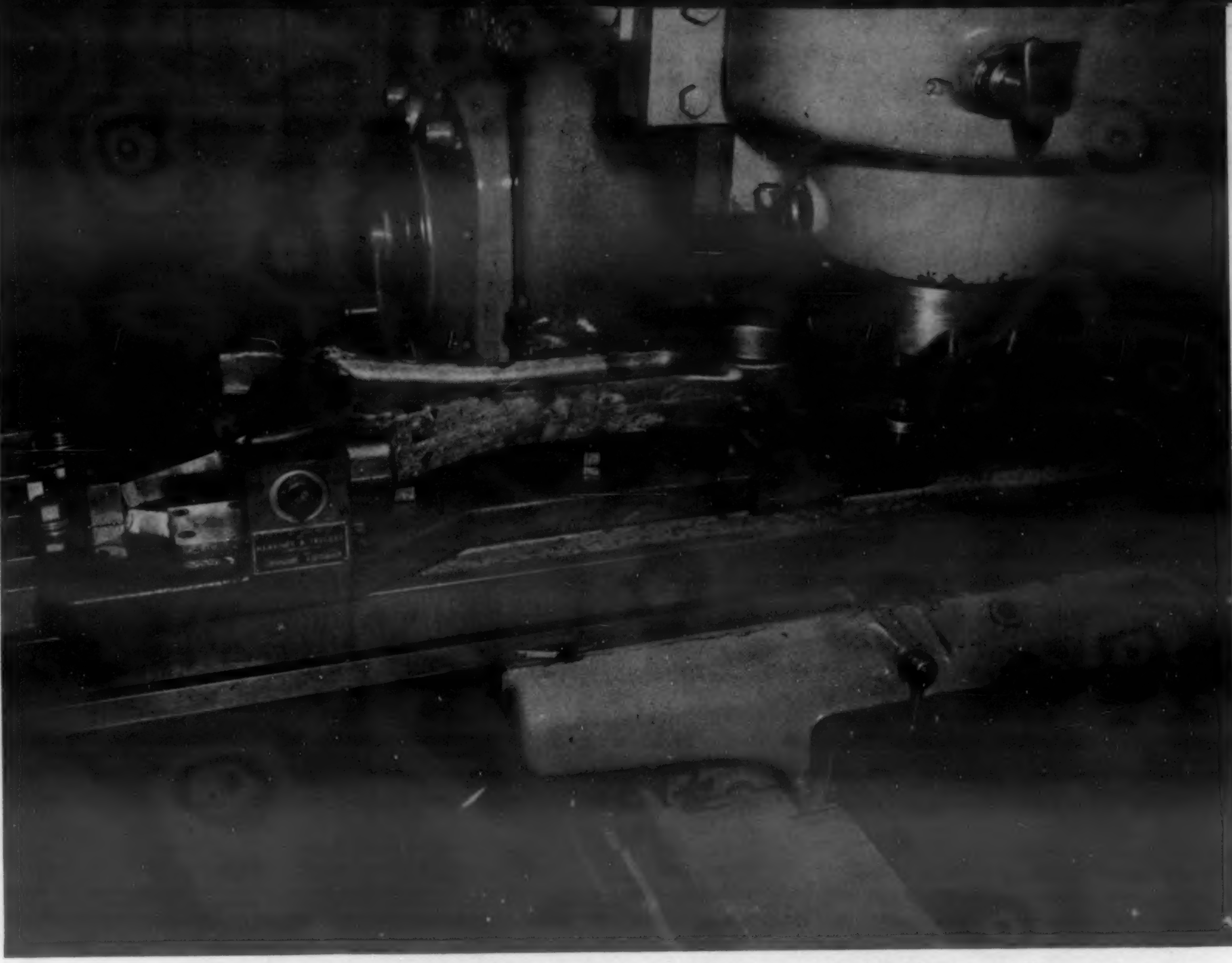
The department of Metal Cutting Research of the Kearney & Trecker Corp. has been engaged for several years in an investigation of the principles of high-speed metal cutting. In the summer of 1944, J. B. Armitage and A. O. Schmidt presented a paper "An Investigation of Radial Rake Angles in Face Milling" before the A.S.M.E. in Pittsburgh. This paper brought out that many of the then current theories concerning high-speed metal cutting with cemented carbides were wrong. In their conclusions, based on a long series of careful tests, it was recommended to position a carbide blade at an extreme *positive radial rake angle,* and to provide *a negative rake face of narrow width at the cutting edge.* This rake angle arrangement was found to be very effective, since it combined the increased strength of the cutting edge afforded by negative radial rake angles and the lower power requirement of positive radial rake angles.

This paper was followed by several others giving more design details concerning a new milling cutter embodying the above-mentioned arrangement of rake angles, and establishing several metal cutting principles relating to tool wear and chip and workpiece temperatures. Another paper covered extensive production runs with three types of cutters whose possible performance previously was disputed.

The material published is conclusive and will guide many production engineers. It helped to eliminate some of the popular but false notions of using extremely high speeds for the cutting of steel, and recommended a now generally accepted range of 300 to 700 fpm. for steel milling.

The papers were favorably discussed and printed in this country and abroad. A cutter designed according to these recommendations will simplify the tool room work, since the same cutter can be used for machining hard steel, mild steel, and nonferrous metals with the highest degree of efficiency. Only the small face at

Specific Nature of Achievement: **The development of fundamental information on high-speed metal cutting with carbide tools, and the wide dissemination of this knowledge to aid both war and peacetime production.**



Here a milling machine designed for carbide milling of steel is working on a diesel engine connecting rod.

the cutting edge needs to be ground differently in order to adapt the cutter for another material. A number of tool manufacturers have already incorporated these desirable features partly or completely in their products. Milling cutters of this improved design have been marketed so far by five companies.

Several other tool manufacturers have also expressed interest in this development. The Kearney & Trecker Corp. has made their metal cutting information freely available to American industry, and reports from many production plants large and small indicate that this war-born development is already helping effectively in the manufacture of peace-time products.

In numerous cases, cutters so designed have performed as follows:

(a) Machined substantially more workpieces between grinds.
(b) Used cemented carbide tool material more economically.
(c) Operated with less virbration and deflection of workpiece.
(d) Consumed less power, as shown by ability to take heavier and deeper cuts without stalling the machine.
(e) Always produced an acceptable finish, with no objectionable burr.

Through a study of the cutting of steel with carbide tools came the development of milling machines specifically for this purpose.

EDITORIAL CITATION *to* ALUMINUM CO. OF AMERICA

For Achievement In

Supersonic Inspection of Aluminum Alloy

The Supersonic Reflectoscope, made by Sperry Products, Inc., is now used in the Massena Works of Aluminum Co. of America for the routine, 100% inspection of aluminum alloy blooms produced on the blooming mill from cast ingots. The purpose is to detect at this initial stage of fabrication internal defects—cracks, splits, segregation, porosity, etc—that may have originated in the cast ingot or from processing in the pre-heating, scalping, or blooming operations.

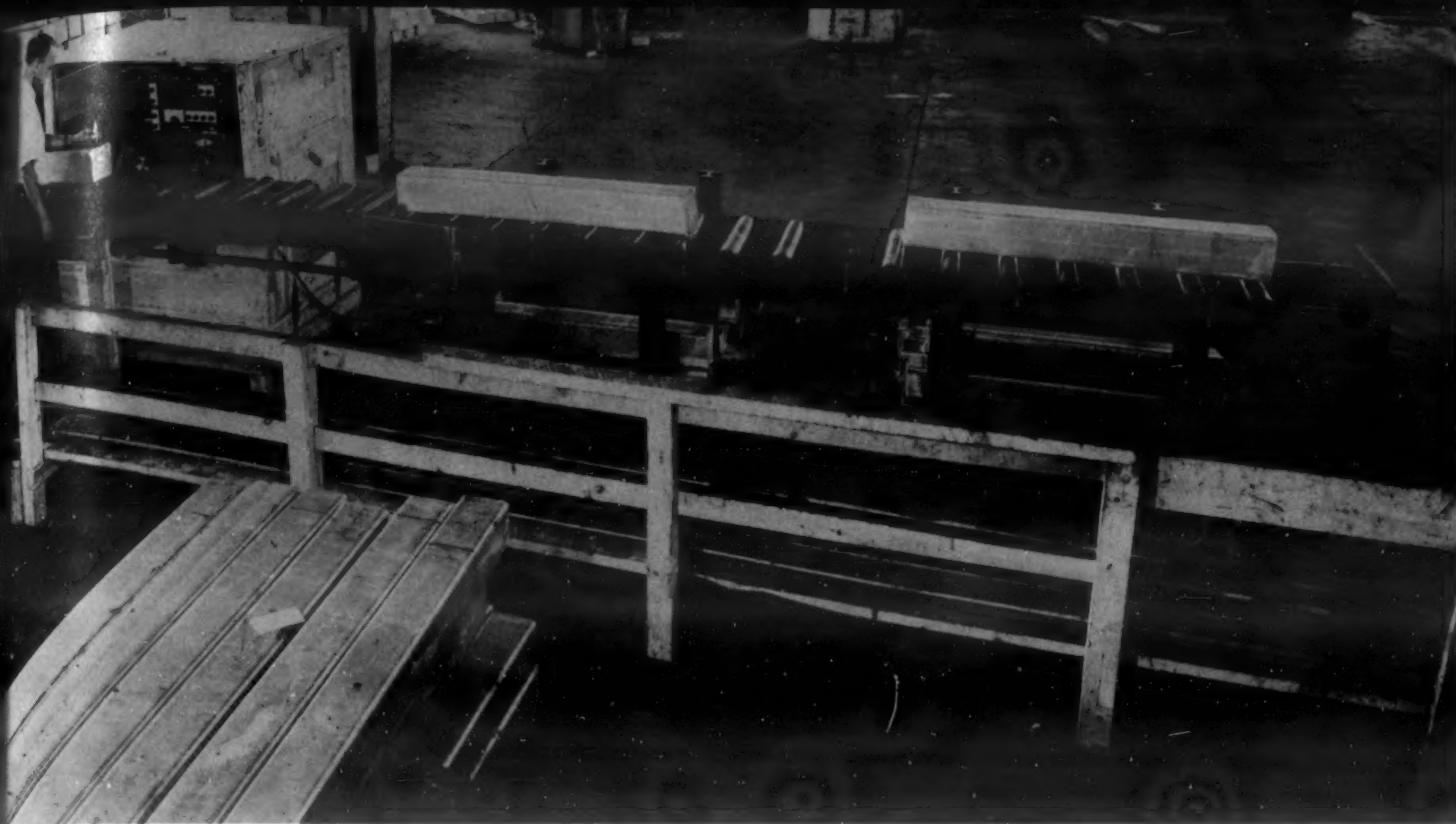
The entire length of each bloom is explored, and defective areas as indicated by the instrument are removed by sawing before the bloom is released for further processing.

This inspection procedure replaces that formerly used, of sawing a slice from the end of each bloom, etching the slice in caustic, and examining it visually for the presence of defects. If any were found, additional slices were taken and examined, until sound metal was found. Considerable judgment was required to interpret the etched sample, and the problem was further complicated if proper care was not exercised in preparing the sample.

The advantages of inspection at an early stage of fabrication are apparent. The manufacturing costs of subsequent operations are saved. Also, breakage that might shut down the mill while the defective material is being removed, with the consequent loss of productive mill operating time, is avoided. In addition, less effort is required to detect defects in a short bloom than in the greater length of wire, rod or shapes that might be produced from it, and there is less likelihood of defective material escaping detection and being shipped to the customer.

The Supersonic Reflectoscope offers the advantage of a non-destructive test that can be applied readily

Specific Nature of Achievement: **For the rapid, production line 100% inspection of aluminum alloy blooms for internal defects, using the Supersonic Reflectoscope.**



Many economies in testing and checking aluminum billets were effected in the Massena Works, Aluminum Co. of America, through use of supersonic inspection methods.

to the entire length of each billet. The slice test gives positive information concerning only the location from which it was taken. While inference can be drawn from the etched sample concerning the presence or absence of certain types of defect in the remainder of the billet, it does not give a check of quality of the entire billet.

By means of the instrument, a crew of four men working four hours inspect the blooming mill production of two eight-hour shifts. For the slice test, a six-man crew working two shifts was required. This represents a difference between 96 man-hours and 16 man-hours, although it is true that a higher class of labor is required for the operation with the Supersonic Reflectoscope.

The cost of remelting saw chips and the slices cut from the billets was a substantial item, which is saved by the use of the instrument. The present overall cost of this more thorough inspection is about one-sixth of the cost of the inadequate slice testing.

At the present time, this operation at Massena is the only routine use of the instrument, but the possibility of its use in other plants of the Company is being investigated. Before adopting supersonic inspection at Massena, the findings of the instrument were checked by cutting up the billets to see whether metallographic inspection would reveal the defects that were indicated. In a great majority of the cases, the defect was found at the location where it was expected. In only a few cases was it not possible to find the supposed defect.

In addition to this routine use of the supersonic inspection method, it is contemplated that it will be a valuable tool in establishing operating practices and in development of ingot casting methods. It is improbable that it will be practicable to apply this type of inspection to 100% of the finished product, but it is entirely possible that it may be useful in controlling manufacturing operations on the basis of the examination of random samples and statistical treatment of the results. It is also possible that the instrument may be useful in the final inspection of finished product for special applications, much as magnaflux inspection is used with steel. For these possible future uses more experience in interpreting the results will be required. As is the case with other of the new inspection tools, for example, magnaflux and "black light," skill and experience are necessary to determine whether an indicated defect is actually a fault that calls for the rejection of the material.

EDITORIAL CITATION *to* **BUICK DIV.,**

General Motors Corp.

For Achievement In

Precision Air Gaging of Metal Parts

The Sheffield Corp. of Dayton, Ohio, during the war developed a method and equipment for dimensional gaging of internal diameters, based on amplified metering of the air velocity passing through orifices in plug spindles, the velocity being directly related to the clearance between the plug and the cylinder bore in each case. This equipment was widely used in the inspection of gun barrels and has been hailed as a major contribution to the war effort.

Buick has adapted this equipment, called the "Precisionaire," to the production-line inspection of cylinder bores, 8 at a time, with marked savings in efficiency, production time and floor space. As now operated the precision air gage will accomplish one complete cycle in less than 60 seconds, thereby checking at the rate of more than 60 entire engine blocks per hour. The instrument checks for diameter, taper and out-of-roundness of 8 cylinder bores of an automobile engine block at 4 different points in each cylinder, and accurately classifies them to 0.0003 in.

The engine blocks are brought to the gage by the conveyor line, then checked and passed down the line to the next operation. The cycle begins with one block in loading position. As the starting button is depressed, loading arms pick up the block and advance it to the gaging position where two hydraulic plungers locate the block and hold it in place. As an additional precaution, a shot bolt enters the locating hole in the top of the block and insures proper location.

Now perfectly aligned, the 8 cylinder bores are entered by 8 spindle assemblies which elevate automatically. Each assembly consists of 4 spindles that float independently to allow for tolerances in hole spacing. Upon reaching the limit of travel, the spindle automatically stops and can be manually rotated through 180 deg. for out-of-round inspection. The spindles can be stopped at any point and rotated 180 deg., if so desired. In the event interference is encountered by any one of the sets of spindles, the machine will stop and a red light indicates the incorrect cylinder bore.

Specific Nature of Achievement: **The application of precision air-gaging equipment, developed originally for inspecting gun barrels, to the mass-production inspection of auto engine cylinder bores.**

The motor block is in gaging position and eight spindle assemblies are inside the cylinder bores. Floats at the top indicate the four dimensions checked in each bore.

Thirty-two Precisionaire indicating tubes are grouped and located at eye level. Each of the 8 spindle assemblies has four-Precisionaire tubes to indicate its findings. A scale graduated in 0.0003 in. and marked off in selection sizes of numbers from 1 to 10 is located to the right of the right-hand tube in each set.

As the engine block is being gaged, the floats instantaneously fall in the tubes to a position opposite a number on the scale. The movable tolerance slide is positioned to determine if all four floats are within the out-of-round and taper limits which are 0.0007 in. If so, the selection size is indicated by the number opposite the float in the right-hand tube. This number is then manually stamped on the engine block directly beside the cylinder bore so classified. Stamping of the selection size of each bore is accomplished by a marking device mounted directly above each of the 8 spindle assemblies. After all cylinder bores have been stamped, the spindle assemblies are retracted and the machine is ready to begin a new cycle. The gaged engine block is removed from the instrument and continues on the production line when the new engine block is carried into gaging position.

The instrument weighs several thousand lbs. and is about 4 ft. wide, 8 ft. long and 7 ft. in height, yet it uses the flow of air accurately to measure to one ten-thousandth of an inch.

Here the operator sets minimum tolerances through use of a master model.

EDITORIAL CITATION *to* **ELLIOTT COMPANY**

For Achievement In

Use of High Temperature Alloys

Gas turbines as such are hardly a brand new development. For the past 10 years, for example, the Elliott Co. has furnished mechanical drive gas turbines for operation on natural gas instead of steam, and hundreds have been used in midwest and southwest oil fields. Such units operate at conditions of temperature and pressure that are less severe than those encountered in modern steam plants.

The gas turbine *power plant,* however, is quite a different story, not only because of its function as a prime mover, but also because it comprises several units whose design and operation must be nicely balanced and especially because its operating temperatures are in the region where metals glow visibly in the dark.

The Elliott Co. has been producing turbosuperchargers for 4-cycle Diesel engines since 1941 and in developing these machines has learned much about high-temperature metallurgy and heat resisting alloys. This knowledge has most recently been and is currently being applied in the production of gas turbine power plants for marine use. The gas turbine plants made during the war used alloys available up to 1943, and performed successfully at temperatures around 1250 F.

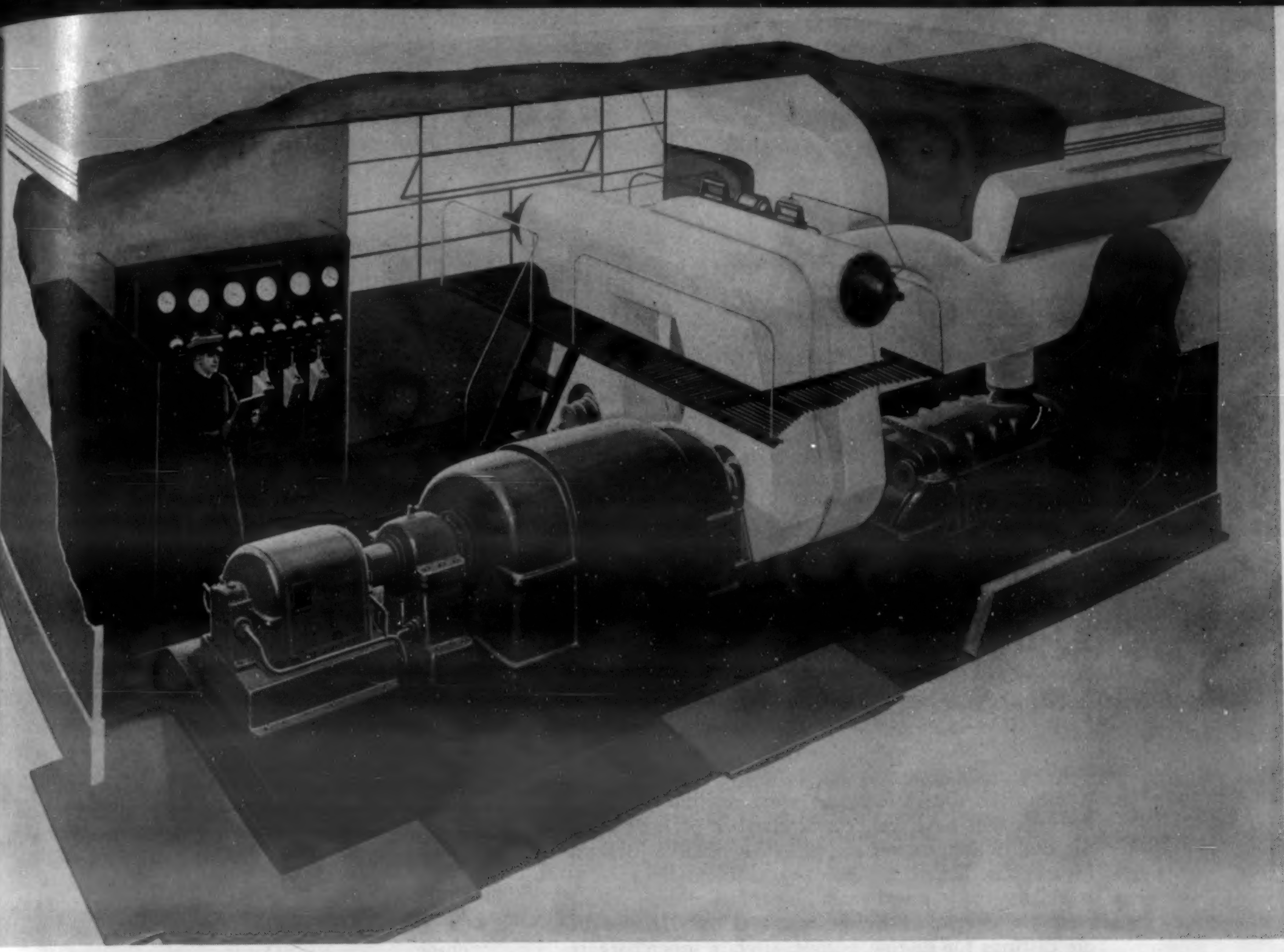
The new Elliott power plants, one of which is for installation on a U. S. Maritime cargo vessel, are 3,000 h.p. units, utilize the very latest in high temperature alloys and will operate at temperatures of 1400 F—considerably higher than their predecessors and with vastly improved operating efficiency.

The present Elliott gas turbine is believed to be the most efficient power plant of this type yet developed and this efficiency is the direct result of the use of the most durable high temperature alloys where highest temperatures are encountered, and the use of less heat durable but more "designable" or workable materials where temperatures are lower but where mechanical design, friction characteristics, or other considerations are important.

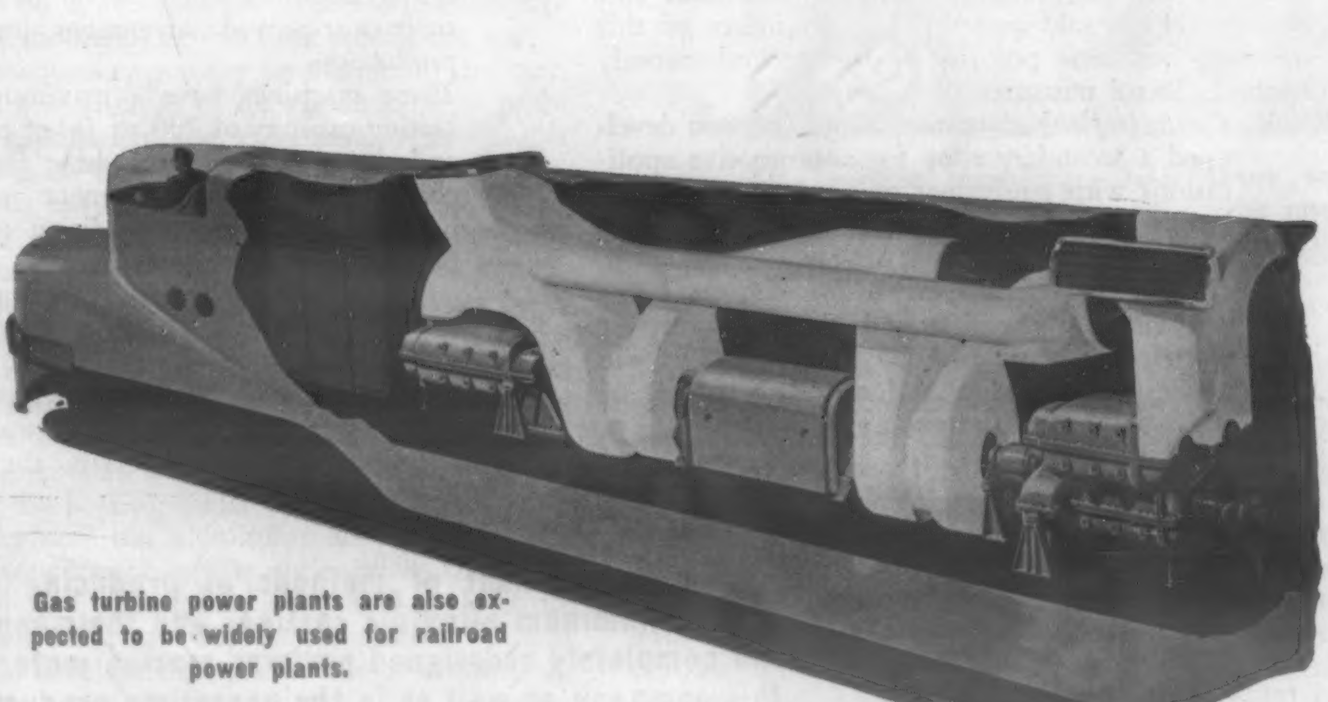
Thus, in various parts of the Elliott gas turbine plant there have been intelligently placed materials ranging all the way from plain carbon steel and Meehanite iron to superalloys of the very latest high-cobalt, high-chromium type. Rolled plate and arc welding have been employed for many intricate parts, to permit the use of stronger materials than are available as castings.

The important point is that each material or method of fabrication has been used judiciously and intelligently, to get the most out of it but not wasting it where it is "too good" for that specific service.

Specific Nature of Achievement: **The improvement in design and construction of marine gas turbine plants, now finding peacetime uses, through the skillful application of both old and new high-temperature alloys.**



War experience with high temperature alloys led to this proposed industrial application of a gas turbine power plant.



Gas turbine power plants are also expected to be widely used for railroad power plants.

EDITORIAL CITATION *to* JOHNSON MOTORS CO.

For Achievement In

Manufacturing Aluminum Alloy Die Castings

American die casters and users of aluminum die castings will have better and cheaper parts at their disposal in the postwar era, primarily because Johnson Motors Co. licked the porosity problem by a combined mechanical and metallurgical approach. Their methods, developed in the wartime manufacture of die castings for marine pumps, aircraft superchargers and the like (and reported to have saved literally millions of dollars for industry and the government) are now being written into the designs and plans for the postwar Johnson "Sea Horse," and into the construction of a new die casting department at the Waukegan plant.

Aluminum die castings once had the reputation of being a "Swiss cheese" material and, accordingly, the Services refused to specify them for critical parts early in the war, despite the often enormous cost savings they would permit. The engineers of this company overcame porosity by three simultaneously applied control measures:

1. *Control of the aluminum alloy.* Johnson developed a secondary alloy for noncorrosive applications with equivalent physical characteristics but less expensive than the standard primary alloy.
2. *Control of the heat required for melting.* Johnson installed the first and largest battery of electric furnaces used by any American die caster, assuring close and complete control of the metallurgical factors in melting. Five 60-kw. Ajax Engineering Corp. furnaces were used during the war period for central heating of the alloys, and three more are on order for the postwar setup. Each furnace can handle 300 lb. per hr. of 1400 deg. metal. In addition, each of the die casting machines is served by 20-kw. Ajax holding furnaces located beside the machine.
3. *The use of large, rugged die casting machines* with controls so flexible that injection speed and very high injection pressures can be adjusted to drive out the gases, fill the cavities quickly and hold pressure on the castings until they are cool—and maintain this schedule on long, fast-cycling production runs. Johnson uses a battery of 14 Lester die casting machines made by Lester Engineering Co. Nine additional machines are now on order to extend their war-proved advantages into peacetime production.

   These machines have a maximum aluminum casting capacity of 200 sq. in. of projected area and about 14 lb. weight, each; five of the machines have pre-fill equipment and the others have accumulators. In addition to their great pressures, the machines feature exceptionally rigid construction to withstand the extra-heavy shock of injection and the slow powerful squeeze that follows.

Complete laboratory control (X-ray, spectrographic, metallographic, tensile testing, etc.) was established for controlling the raw materials, the die casting

Specific Nature of Achievement: **The development of methods of producing sound and strong aluminum alloy die castings and their application in the completely redesigned postwar marine motors made by this company as well as in the peacetime products of other manufacturers.**

Here is one of the Lester die casting machines used by Johnson Motors. In the foreground is an electric holding furnace.

process and the cast products, and will be continued and even expanded in use for controlling the peacetime die casting operations of this plant.

The results of all this: Originally the Services opposed the use of aluminum die castings because of their notorious porosity. Johnson Motors applied their new ideas to a delicate instrument housing, produced castings without objectionable porosity, sold the Services on it, and then proceeded to manufacture hundreds of thousands of this item during the war.

As a consequence, porosity in aluminum die castings within a wide range of sizes is no longer a problem. The production and cost advantages of this 3-front attack on the overall engineering and operating problems have been demonstrated beyond argument. Now they are being applied in the postwar manufacture of die castings.

Thus, the original Johnson "Sea Horse" was made of cast iron, bronze, brass and steel. With the introduction of die casting, first a few and then more and more parts were cast in aluminum or zinc. Drive shafts, gears, bolts, screws, etc. are still made of steel, and bearing surfaces are special bronze or steel (but even here, the bearing shells are inserted in the die casting dies and the aluminum alloy cast around them). Except for these parts, substantially the entire postwar Johnson outboard motor will be made of die castings, something that would be impossible without the wartime development of methods of eliminating porosity.

The extent to which these practices are to be applied in their peacetime production is shown in Johnson Motors' new die casting department, now under construction. It will be the first "captive" die casting department to be entirely self-sustaining with respect to die facilities, raw material storage, flash and gate-removal, and machining equipment and shipping facilities. It will be the first industrial die casting plant with an annual production in excess of 12,000 tons, the first to be fully equipped throughout with electric furnaces, and the first to utilize as many as 31 die casting machines on aluminum alloys.

The aluminum supercharger rotor shown top center was produced on these dies. The rotor operated at 30,000 r.p.m.

EDITORIAL CITATION *to* LANDIS TOOL CO.

For Achievement In

Centerless Grinding of Threads

The centerless thread grinder which is the subject of this citation was developed by Landis during the past three years to fill the need for a method of producing screw threads that would be highly accurate and provide a smooth surface, and which would offer hitherto unavailable production economies.

The principle of the centerless thread grinder is the idea that a blank, entering the throat between the grinding wheel and the regulating wheel, would index itself in grooves in the grinding wheel, in the same manner as a thread die indexes itself. The grinding wheel, like the thread die, is formed so that the blank can enter the throat and the full thread depth is attained at the opposite side of the wheel. The grinding wheel is formed by crushing, the crushing roll having a series of parallel grooves corresponding to those to be formed in the grinding wheel.

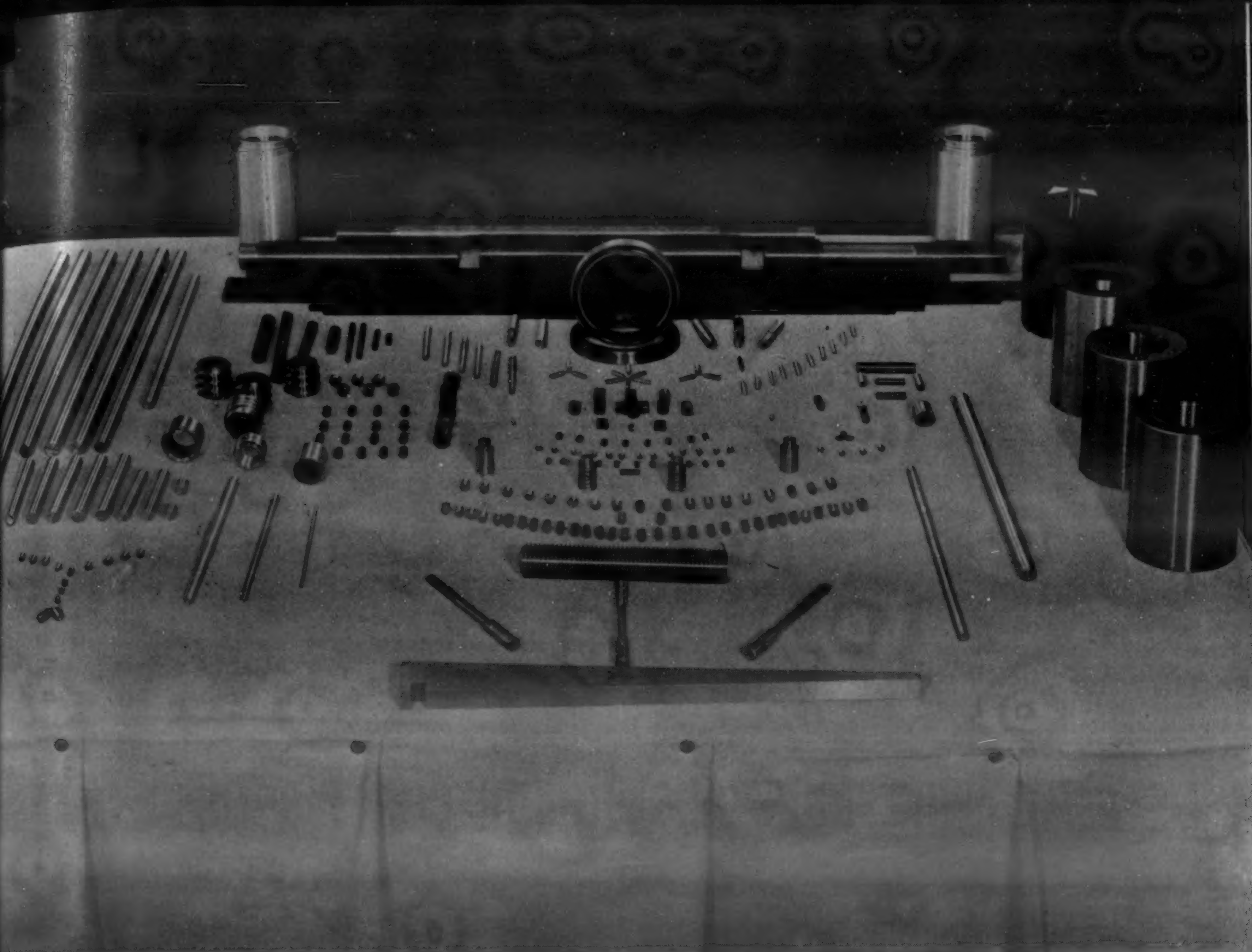
The use of this idea and machine has introduced a fundamentally new method of producing threads in metals with several distinct advantages. For example, an economical grinding rate on 1/4 in.-20 screws of hardened steel is about 30 to 35 in. per min., at which rate the wheel can operate continuously for 8 hr. without needing recrushing.

Accuracy in the lead of the thread is better than 5 ten-thousandths of an in.; by reducing speed the error may be held to 1 ten-thousandth.

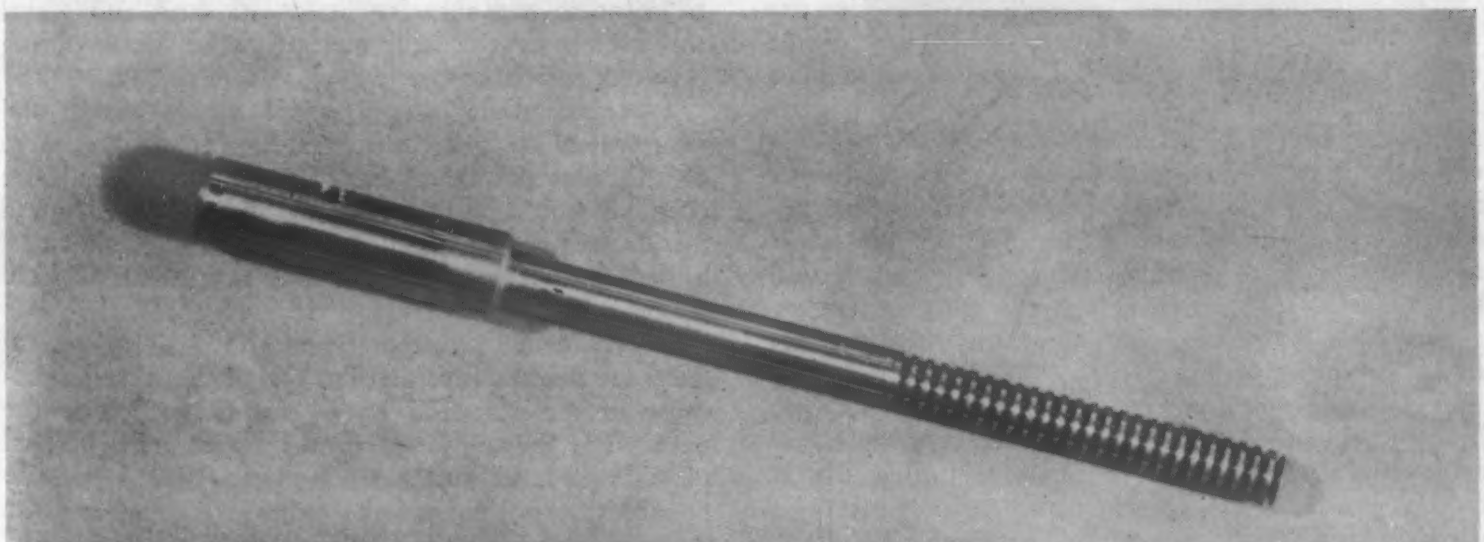
The process has been distinctly useful to a number of metalworking plants, for whom it made possible results not previously obtainable. For example, Parker-Kalon Corp., New York, employs centerless thread grinding on sockethead setscrews and reports enthusiastic reception by their customers. Parker-Kalon hails the process as making available on a quantity production basis results previously obtainable only by slow-production precision methods. They form the screws from hardened stock, getting a mirror-smooth, bright appearance that is a 100% improvement over the conventional tool-marked cut thread set screws. Accuracy is to a class 3 fit.

Another field in which the process is used to distinct advantage is in producing threads on powder metallurgy parts. As is well-known, threads cannot be pressed into such parts; in addition, all cutting operations on powder parts are extremely difficult because of the porous structure of the materials. Three manufacturers of powdered iron tuning cores for radio work are finding the process unusually successful, giving them production rates far in excess of other means, with improved accuracy and thread finish.

Specific Nature of Achievement: **For the wartime development of a method and equipment for centerless grinding of threads, now being applied to several peacetime products.**



Here are a large group of parts finished by centerless thread grinding. Parts include worm and lead screw threads, socket-head screws and threaded powder metal parts.



This interesting job produced by centerless thread grinding is a ¼-in. circular rack produced in about 1¼ min. to an accuracy of 0.0001-in. in 1-in. length.

EDITORIAL CITATION *to* **NORTH AMERICAN AVIATION, INC.**

For Achievement In

Applying Fiberglas-Reinforced Plastics

During the past several years North American Aviation, Inc., has been carrying on a program evaluating Fiberglas-reinforced plastic for aircraft use. Considerable progress has been made to date, and many Fiberglas plastic parts are now being employed. Design and fabrication practices have been developed and material-and-process specifications have been established for Fiberglas plastic parts.

The reasons for adopting Fiberglas plastic parts are many and varied. For some parts, the nature of the electrical requirements alone demand the use of a Fiberglas part. The dielectric properties of a glass fiber laminate, e.g., make it very satisfactory for radomes. Again, Fiberglas plastic vertical stabilizer tips not only provide the required insulation for antennae mounted within the tips, but also are fabricated less expensively than metal tips, which would be drop hammered in two parts and then welded together. Their use also eliminates the need for external mounting of the antenna.

A Fiberglas plastic wing tip, now in production, besides being more easily and less expensively fabricated than a metal tip, is a more satisfactory part both from appearance and a performance standpoint. The plastic tip was installed on an experimental flight airplane. After a certain number of flight hours, the plastic tip's condition was compared with the typical damage sustained by a metal tip under similar service conditions. The toughness and resiliency of the Fiberglas plastic material is such that the plastic tip was apparently unaffected by the forces that would permanently dent a metal tip.

Another part made of Fiberglas-plastics is a wing bomb rack fairing. This part is fabricated at a lower cost than a metal fairing. The resiliency of the glass fiber material makes the fairing more durable and resistant to the abrasive action of sand and gravel thrown up by the tires and propeller blasts during take-offs and landings.

Fiberglas plastic was chosen for NAA's heat and vent system cockpit control valves, because the valve of this material could be manufactured at a lower cost and would be lighter in weight than if it were a metal casting, and because it could be held to closer dimensional tolerances than was possible if it were of sheet metal fabrication.

Experimental heat and vent and de-icing system ducts are made with Fiberglas plastic construction because of the ease and lower cost of producing the parts. The lower cost of producing an experimental plastic part having such a complicated shape is made possible by the inexpensive tooling required and the lower production costs of the plastic part as compared to a metal part.

The cost of the plastic duct, in low quantities, is considerable less than that of the metal duct. How-

Specific Nature of Achievement:

The application of Fiberglas-reinforced plastics in aircraft parts previously made of metal.

This wing bomb rack fairing was made of Fiberglas plastics at a lower cost than metal fairing.

ever, the total cost of the metal duct decreases more rapidly than the cost of the plastic duct as the production quantities increase because of the greater amortization of the metal tooling costs. At a production quantity of approximately 100 parts, the total cost of the metal part becomes less than that of the plastic part.

In addition to being lower in cost, in experimental quantities, the Fiberglas plastic is generally more satisfactory than metal for ducts having complicated shapes, because of the distortions and irregularities that are usually produced in the sheet metal parts when they are torch welded.

The desirability of Fiberglas plastic parts is hinged upon their inherent advantageous properties and characteristics, such as lightness of weight, durability, high dielectric strength, noncorrosiveness and economies of manufacture. However, the main use of Fiberglas parts is predicted upon these parts being less expensive than metal parts for low production runs.

Before Fiberglas plastic parts could be successfully fabricated, many production problems had to be solved. The most desirable type or types of materials, fabric and resin had to be determined. Methods of application of resin had to be developed. Suitable parting or releasing agents had to be found or developed. An inexpensive tooling had to be developed for experimental parts, as well as production runs. Satisfactory answers have been found for most of the problems involved, and the result is a good example of applying war-developed knowledge to peacetime products.

Heat and vent ducts for aircraft were made of Fiberglas plastics because of the ease and low cost of production.

EDITORIAL CITATION *to*

WILLIAM WERME,

General Superintendent,

Worcester Pressed Steel Co.

For Achievement In

Cold Forming of Brass

During the war this company worked out a technique for forming the British 4.5 howitzer shell cases, which were produced out of "cartridge brass" about 0.250-in. thick. The howitzer case was 3¾-in. high, 4¾-in. o.d. with a thick base and thin walls, plus a "mean" flange around the base. The special practice developed for this product involved coordination of tooling, especially correlating blank size and design of drawing tools, since the material that was to provide the flange had to flow entirely from the base of the cup and still retain the required dimensions; therefore, the angular curve of the base had to be very carefully plotted in the tool design. In addition, a high ratio of anneals to other operations (blanking, drawing, ironing, squaring, striking, restriking, etc.) was found necessary.

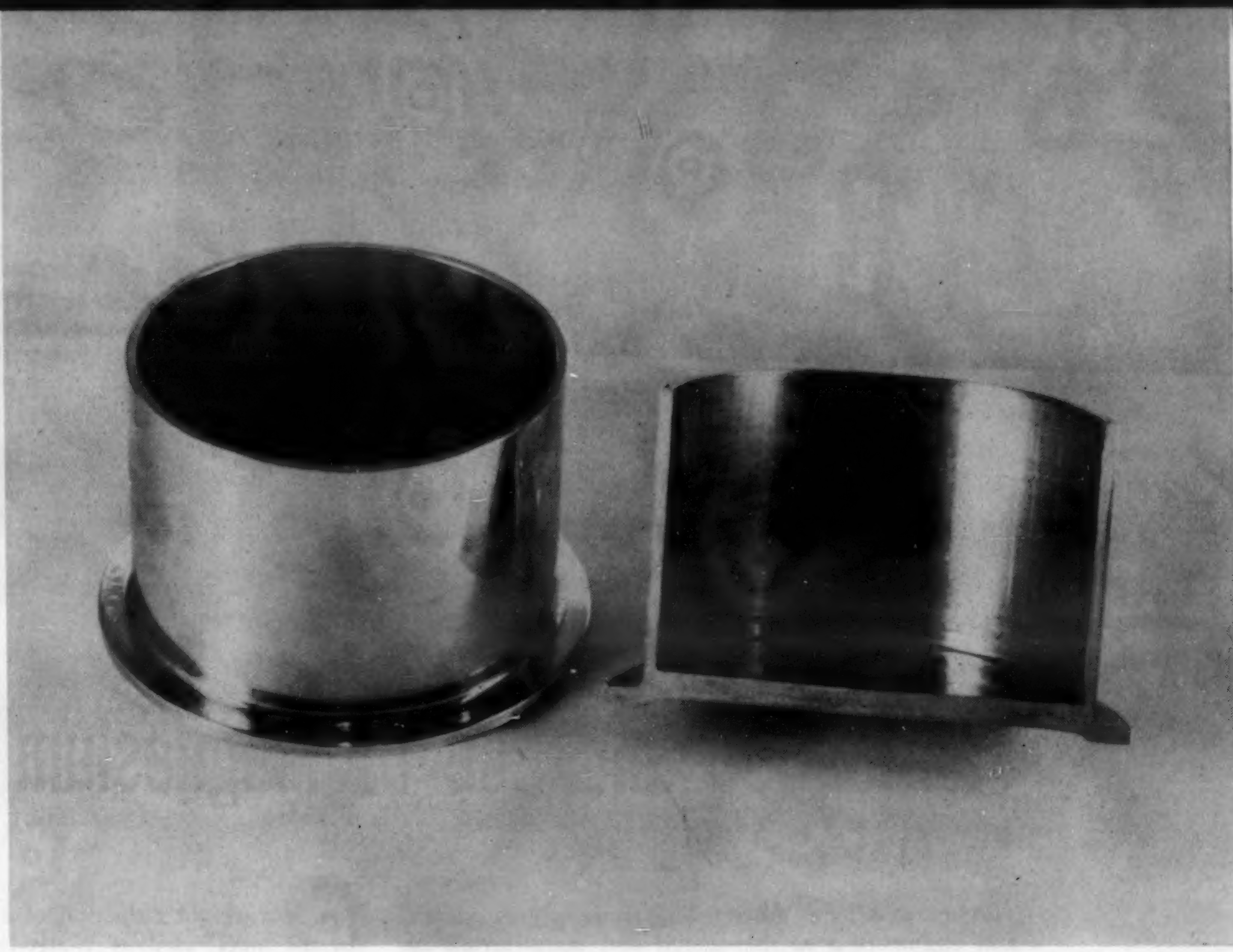
Later the Chelsea Clock Co. asked the Worcester Pressed Steel Co. to investigate the possibility of replacing the expensive bronze castings used for the cases of their ships' clocks and maritime dial instruments, with cold-formed brass cases. Certain similarities with the howitzer case problem were at once perceived. The new case had to be flat or concave on the bottom (so that it would screw or bolt flush on a wall). It had to be flat and without radii on the inside (to accommodate the works). It had a thick base (0.250 in.) and thin walls (0.114 in.) for resonance, with a ⅜-in. flange at the base.

The material was commercial brass, somewhat harder to work than cartridge brass and about the same thickness for both parts. In general tool construction, heat treating, cold working practice, equipment (single-action presses), etc. could be similar for both jobs.

But there was one important difference that presented a new problem: The large radius permitted on the inside bottom of the howitzer case was not permissible on the clock case, because of the space

Specific Nature of Achievement: **The successful application of a sheet metal forming technique, developed originally for brass howitzer cases, to the production of cold-formed brass cases for maritime clocks and instruments.**

A full and cross-sectional view of a brass clock case, showing the problems involved in drawing it.



required for the clock's works. And with the original upsetting and flanging operation a shoulder on the inside of the cup and an inadequate flange resulted.

This was solved by making two operations instead of one, coming down more lightly on the first strike; just enough to start the flange without creating an inside shoulder. Then on the second strike the tool was redesigned to permit a spring arrangement to always hold the bottom knockout to the full depth of the cup. This eliminated the shoulder and permitted a wide thin flange, meanwhile maintaining the 0.250 gage bottom of the cup. But again another problem —since the flange had to be on a different horizontal level than the bottom, the corner had a tendency to crack on the inside and pull or stretch the stock on the outside, creating strain marks.

Only by a careful coordination of several factors was this condition removed. First, the case had to be squared to exactly the right height. Second, the bottom knockout should have exactly the correct amount of spring tension in the restrike, and third, the pressure and speed of press travel had to be carefully governed. With a complete coordination of these factors the result was an excellent example of wartime acquired knowledge put to a peace-time use, coupled with new progress created where the situations were not parallel.

These drawings show the similarities and differences between the brass howitzer cases and clock cases produced by drawing.

EDITORIAL CITATION *to* **WARREN McARTHUR CORP.**

For Achievement In

Fabrication and Use of Magnesium Alloys

As early as 1930 Warren McArthur applied science and engineering to the design and manufacture of seats for such specialized service as in steamships, railroads and airplanes. A unique standardized unit design was built of aluminum for lightness and strength.

In 1939 aircraft manufacturers realized the importance of seating in relation to the safety and efficiency of fliers and the Warren McArthur Corp. was invited to apply its knowledge and experience to the problem. As a result, Warren McArthur advanced technical seating was used in over 85% of military and combat planes built in the U. S. during the war. The combined prewar and wartime experience is now being applied to seating on all major airlines in this country to add to passenger safety and comfort and increase capacities through weight savings effected by using magnesium.

Seeking to create the best and lightest seats for fighting planes, Warren McArthur engineers investigated magnesium attempting to further reduce weight while maintaining or increasing strength and shock resistance. Impetus was added to this research with the announcement, in 1940, that magnesium successfully could be arc welded, since the high strength aluminum extrusions and sheet then in use were not adapted to this method of joining. The use of welding was seen to offer distinct advantages in seat design and construction. By 1942 this company was successfully arc welding magnesium in commercial production. Also, it had developed production methods for bending tubing and improved techniques for drawing sheet. The use of magnesium over aluminum netted a weight reduction of 20% in seats, so today, of the metal used in Warren McArthur seats, 80% is magnesium.

Warren McArthur welding achievements have greatly extended the possibilities for structural use of magnesium. Development of arc welding of this light metal into a production method involved the solution of numerous operating problems, but the outstanding single advance is the a.c. high frequency method of welding. Welding magnesium with a.c. equipment had been unsuccessful before the use of high frequency current because a steady arc could not be maintained. For example, in using 60-cycle current, reversal caused extinguishing of the arc. In the new method, high frequency current (about 200,000 cycles) is superimposed on the welding current and higher voltage is used, thus stabilizing the arc. Today, the construction of aircraft seats utilizes 58 high frequency magnesium arc welding stations in the plants of McArthur and one subcontractor—a larger volume than is available throughout the remainder of this country.

A second important contribution to the mass production processing of magnesium is a tube bending technique. Because of directional stress strengths involved in seats, square magnesium tubing is used extensively. Since magnesium is formed hot, standard methods used for aluminum were not suitable, so McArthur engineers devised a magnesium-tube bending machine. Its entire operation is automatic: the straight cold tube, fitted with a jointed mandrel, is inserted in the machine where it is heated, bent and released. Bending rolls are heated to a high tempera-

Specific Nature of Achievement: **The application of magnesium alloys, of improved methods of arc welding magnesium and of new tube-bending techniques, in the construction of light weight and highly comfortable aircraft seating.**

To utilize magnesium to the fullest extent, McArthur engineers developed advanced methods for welding and forming that material.

ture and when the tube has reached the proper forming temperature, by contact, electric relays activate the bending mechanism and then release the tube. Exact temperature control for bending has been devised for each size and wall thickness of tubing used. Bends are consistently good and true to required tolerances.

In addition to these two important developments, McArthur engineers utilized to the utmost the inherent characteristics of magnesium and adapted methods already developed for handling magnesium to their production requirements. These methods include: using electrically heated dies for drawing magnesium sheet not only for forming but also to bring sheets to proper temperature and using magnesium for screw machine parts, die cast fittings, stamped and spot-welded assemblies, and fittings routed from plate. In the mechanism for adjusting seat backs, for example, magnesium rolls operate directly in a groove routed in a magnesium plate, giving perfectly smooth and serviceable operation.

At war's end, Warren McArthur converted from production of military aircraft seats to production of crew and passenger seats for commercial planes. Conversion of military planes created a huge demand for McArthur seating, as did the rush of new passenger plane building. Although seats are different in design, the same design thinking and processing techniques are being applied to the peacetime product. One airline reported that Warren McArthur seating resulted in sufficient weight saving to carry one additional passenger; another announced a saving of 157½ lb. per plane. Present trends towards luxury and gadgets make weight saving in framework imperative.

Aircraft seats are important to passenger safety and must withstand stresses many times more complex than simply bearing a person's weight. The specification for belt load alone on passenger seats is 1200 lb. In two recent crash landings of planes equipped with Warren McArthur seats no passengers were injured and no seat failures occurred, although the planes were seriously damaged.

An example of the type of aircraft seat which utilizes magnesium to provide the strength and lightness necessary for the application.

The extensive use of magnesium in these seats has been the major factor in reducing their weight. Warren McArthur seat model 290, used in the Lockheed Constellation, is a good example of the type of seat now being produced. All metal parts except the stretchers are magnesium. Dowmetal FS-1 tubing is used in various sizes, including 1-in. and 1¼-in. squares with 0.083-in. wall and 1⅜-in. square with 0.065-in. wall. A single seat weighs 29 lb. completely upholstered.

EDITORIAL CITATION *to* THE VISKING CORP.

For Achievement In

Polythene Plastics for Packaging

Polythene, or polyethylene, is a tough, horny, translucent, whitish material usually marketed in granular form. Only a small quantity was produced prior to the war, and for security reasons, information concerning the resin was not made public until toward the close of the war.

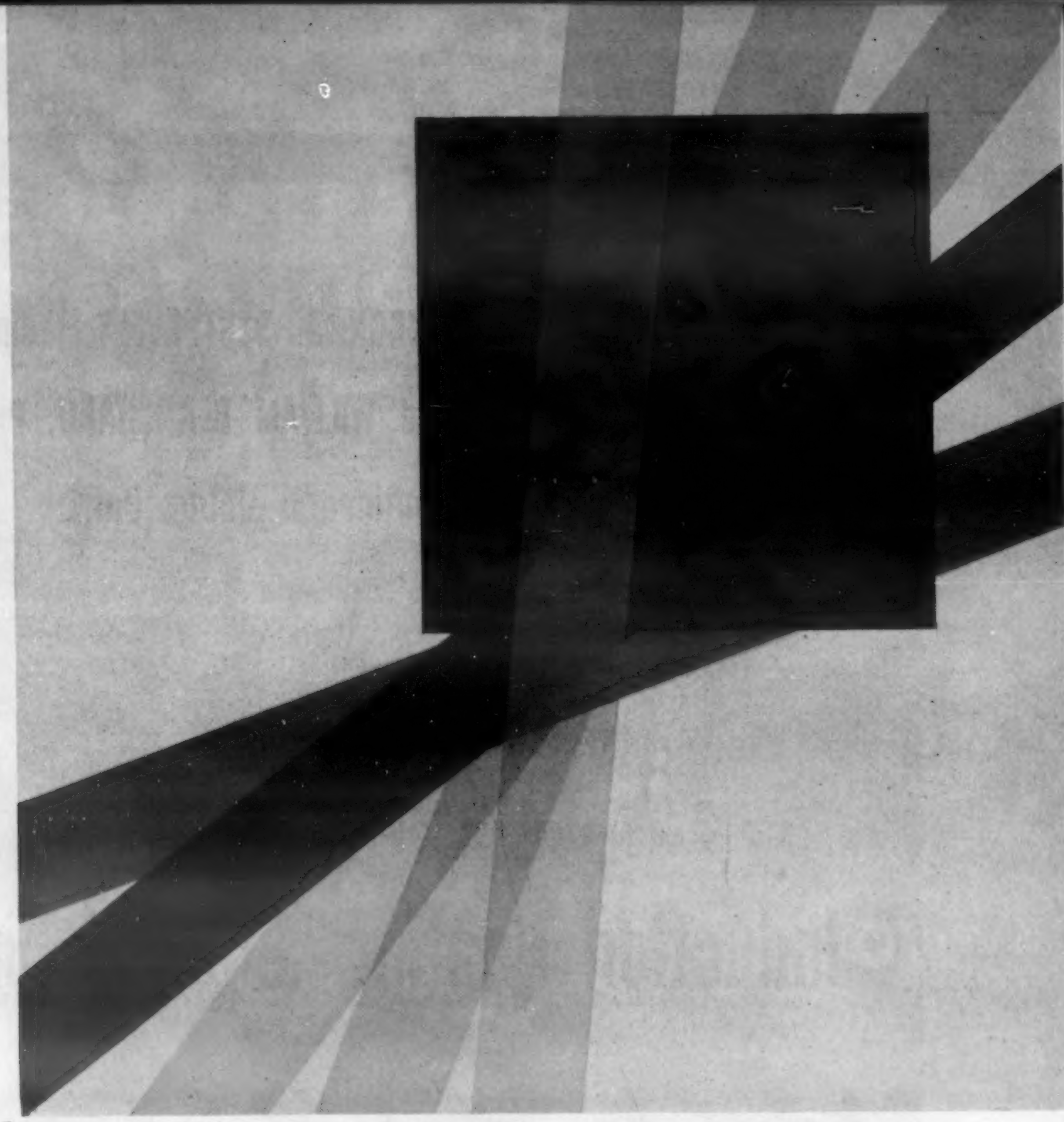
Some of this resin was allocated to Visking in the fall of 1944 for experimental purposes in the interest of the Army. The company was a large producer of small arms covers, which originally were made from other materials and by entirely different processes.

After considerable experimental and development work carried on by the Plastics Development Div. of Visking, with the valuable assistance of the resin producers, E. I. du Pont de Nemours and Carbide & Carbon Chemicals Corp., unique equipment was built from which the production was submitted to the Research & Development Div., Quartermaster Corps, with the result that specifications for polyethylene tubing for protective covers were drawn and large contracts were placed with Visking. Production began in a separate plant of the company on March 19, 1945 and, as new military uses for the material developed, was rapidly expanded.

Among the large-scale military uses for Visking's polythene film were pistol, rifle and carbine covers, gas mask and emergency signal flare containers, and the outer wrap of the assault food package.

After the war ended, production continued to expand as the valuable properties of the film became widely recognized. Larger sizes, a wider range of thicknesses, and a selection of numerous colors are now offered, and polythene film, first produced on a commercial scale by Visking, now has widespread distribution and acceptance for its unusual and valuable properties. Special sealing and printing methods

Specific Nature of Achievement: **Utilization of a new synthetic plastic polymer (polyethylene or polythene) in producing sheeting and tubing for protective packaging of war equipment and subsequently for a host of peacetime industrial products that have been much improved thereby.**



Developed during the war as protective covering for many military items, polythene sheeting is finding extended use as a packaging material.

have been developed and have been made available to the users.

Visking polythene film is produced in rolls of sheeting up to 48 in. wide, in rolls of seamless tubing from ¾ in. to 30 in. in dia., in thicknesses from 0.0005 in. to 0.020 in., and in 8 stock colors and a wide range of other colors to order. A special grade having superior electrical properties is also available.

The film is softly lustrous, transparent in thin films, but slightly milky. The tensile strength of about 2,000 psi. is not exceptional; the elongation is about 250%. The film is tough, with good resistance to tearing, and at low temperatures its physical properties remain unimpaired to a remarkable degree; brittleness does not occur until a temperature of −50 F is reached. It is very resistant to the effects of weathering, sunlight and ozone, softens sharply at 221 F, and is slow burning after ignition.

The density of the film (0.92) is lower than any other commercial film. It will not cling or "block," as it is called. The moisture diffusion constant is very low, and water absorption is of the order of 0.01%. The film contains no plasticizer, softening agent or coating; there is no constituent which will evaporate, migrate or crack.

Visking polythene film is unequalled in the qualities of insolubility and chemical inertness; no active solvent at room temperatures has been found for it.

Electrically, it is a non-polar material, with an extremely low power factor, low dielectric constant, high resistivity and high dielectric strength, over a wide frequency range. It is outstanding for insulation of high voltage and high frequency equipment.

In the metal industries, polythene film is used as containers and bags to protect small parts against rust and contamination, as insulation for electrical parts, as a tape to wrap plating racks, gaskets for low temperature use, and as tank linings.

Other industrial uses include food containers of many kinds, wrapping for gasket material to prevent loss of constituents and deterioration, containers for chemicals, greases, and pharmaceuticals, protective garments, and wraps for cable splices.

In consumer goods it is widely used for rainwear, shower curtains, garment bags, refrigerator bags and covers, table and lamp covers, and as yard goods.

A complete list of uses would be a lengthy one, and new applications are steadily being developed. As a general statement, where maximum chemical inertness, long life and great stability, protection against moisture changes, high dielectric strength, and flexibility at very low temperatures are required of a film to be used as a covering, container or garment, Visking polythene film is a general choice.

EDITORIAL CITATION *to*

MYRON J. BESTERVELT, Induction Hardening Supervisor, and WILLIAM BLANCHARD, Processing Dept., Continental Motors Corp.

For Achievement In

Induction Heating and Spinning

The governor sub-assembly in question was originally designed to consist of 3 parts—a shaft, cup and button. The shaft was drilled and reamed to a tolerance of 0.0005 in. and the button shank was held to the same limits. The radius of the button was spherically formed and then ground in an oscillating grinder. All these were expensive operations. The shaft and bell were hydrogen brazed; then the previously carburized bell was quenched and last, the cyanide hardened button was pressed into place. The cost of the part by this practice is $1.98.

This company's wartime experience with induction heating and with spinning led them to try a wholly different production procedure that would be simpler and cheaper. First they decided upon spinning the button, and making it integral with the shaft. This worked very well, eliminating a costly part entirely, and making the shaft more simple. They now use only the bell—or cup—and a shaft with a larger shoulder. This shaft, made from 1141 steel, spins very well; the operation is extremely simple and is done in 5 to 10 seconds.

The second innovation was to induction braze the parts together and to induction harden the button simultaneously, using a pancake coil opposite the button to heat it to approximately 1550 deg. F at which time a jet of water is directed on the button. After much experimental work it was found possible to have the heat gradient meet the requirements of 1550 deg. at the button and 1250 deg. at the base of the shaft, which caused the preplaced ring of silver solder to form a radius.

Originally this assembly consisted of a shaft, cup and button. By redesigning the shaft and utilizing brazing and spinning, one part and several expensive operations were eliminated.

The price of this part as now made by this new method is $0.75 (including overhead), a saving of $1.23, or 62%.

Specific Nature of Achievement: **The application of induction brazing-and-hardening (in one operation) and of metal spinning to the simplified, lowered-cost production of a governor sub-assembly.**

SPARK PLUG ILLUSTRATES VALUE OF CAREFUL SELECTION AMONG REVERE METALS

Progressive steps in machining terminals out of Revere Free-Cutting Brass.

Progressive steps in producing gaskets of Revere Silver-Bearing Copper.

THE automobile industry, an important Revere customer, is noted for the extreme care it uses in lecting among the many Revere Metals. This careful lection assures speed and economy in manufacture, d protects reliability of operation in the hands of e ultimate user.

Take, for example, the Auto-Lite Spark Plug. The rminals are made by the millions in automatic screw achines. The stock is Revere Free-Cutting Brass, hich permits high turning speeds, accurate threads, d a fine finish.

Gaskets, three to each plug, are punched and formed t of Revere Silver-Bearing Copper. This metal was osen in order to prevent annealing during operaon, thus retaining the spring tension which is necesry to prevent leakage or "blow-by" past the gaskets.

Revere Metals include: *Copper and Copper Alloys:* heet and Plate, Roll and Strip, Rod and Bar, Tube and Pipe, Extruded Shapes, Forgings; *Aluminum Alloys:* Tube, Extruded Shapes, Forgings; *Magnesium Alloys:* Sheet and Plate, Rod and Bar, Tube, Extruded Shapes, Forgings; *Steel:* Electric Welded Steel Tube.

Perhaps your product could benefit by a careful study of the varied forms, qualities and characteristics of the Revere Metals. The Revere Technical Advisory Service will gladly cooperate with you.

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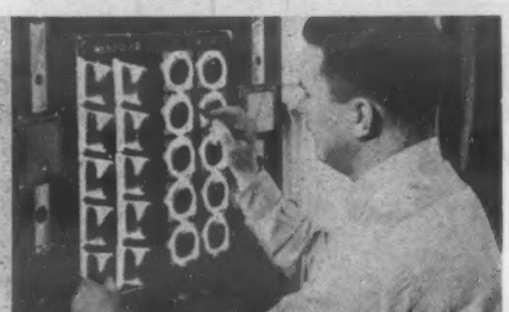
HAYNES precision castings are mass-produced

...AND 100% TESTED FOR QUALITY

These conveyors along the wax pattern assembly lines make possible greater output of wax patterns per man-hour.

Zyglo inspection—a penetrative oil test—under black light reveals cracks or other surface imperfections present.

Trays of castings are passed through 250,000-volt automatic X-ray equipment for the final check on quality.



Trained operators check all X-ray negatives closely to detect any flaws that would make the part unsuitable for use.

This new building for Haynes Stellite Company at Kokomo, Indiana, is designed for straight-line mass production of precision castings from quality alloys. With this addition to its facilities, the company is equipped to produce simple or intricate parts that withstand the toughest service.

HAYNES precision castings are uniform in quality, soundness, and dimensional accuracy. Every casting shipped is tested to be sure it conforms to required dimensional, metallurgical, and chemical standards.

For further information write for the booklet "HAYNES Precision Castings."

A variety of jigs and gages makes possible rapid and accurate checking of all critical dimensions.

HAYNES
TRADE-MARK
Alloys

Haynes Stellite Company
Unit of Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
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The registered trade-mark "Haynes," distinguishes products of Haynes Stellite Company.

Preview

National Metal Congress and Exposition

Introduction

Atlantic City is the scene this month—November 18 to 22—of the 28th annual National Metal Congress. All of the participating societies have prepared technical programs that will include the greatest number of papers yet presented at a Congress. Officials expect in excess of 15,000 persons at the Congress and concurrently held Exposition.

Participating Societies

The American Society for Metals sponsors the National Metal Congress, and this year others participating are the American Welding Society; the Iron and Steel Div., and Institute of Metals Div., American Institute of Mining and Metallurgical Engineers; and, the American Industrial Radium and X-Ray Society. Headquarters for the groups are as follows: ASM, the Traymore; AWS, the Ambassador; AIME, the Claridge, and AIRXS, the Seaside.

The Exposition

This year's exposition is expected to have over 400 exhibits of companies whose products or methods cover all aspects of the metal producing and consuming industries. The exposition is to be held at Convention Hall, scene of ASM technical meetings. Monday, Tuesday and Wednesday, Nov. 18, 19 and 20, the exposition will be open from 12:00 noon until 10:30 p.m. The final two days, Thursday, Nov. 21, and Friday, Nov. 22, hours will be from 10:00 a.m. until 6:00 p.m.

Special Events

American Society for Metals

The ASM annual meeting is to be held at 10:00 a.m. Wednesday. Following reports of current officers, election of new officers is to be held. After the business meeting the Edward de Mille Campbell Memorial Lecture will be presented by J. B. Austin, U. S. Steel Corp. The banquet is to be held Thursday evening at the Traymore Hotel. Features of the banquet include presentation of the Albert Sauveur Achievement Award to Dr. E. C. Bain, U. S. Steel Corp., and the ASM Medal for the Advancement of Research to Dr. R. E. Zimmerman, also of U. S. Steel Corp.

American Welding Society

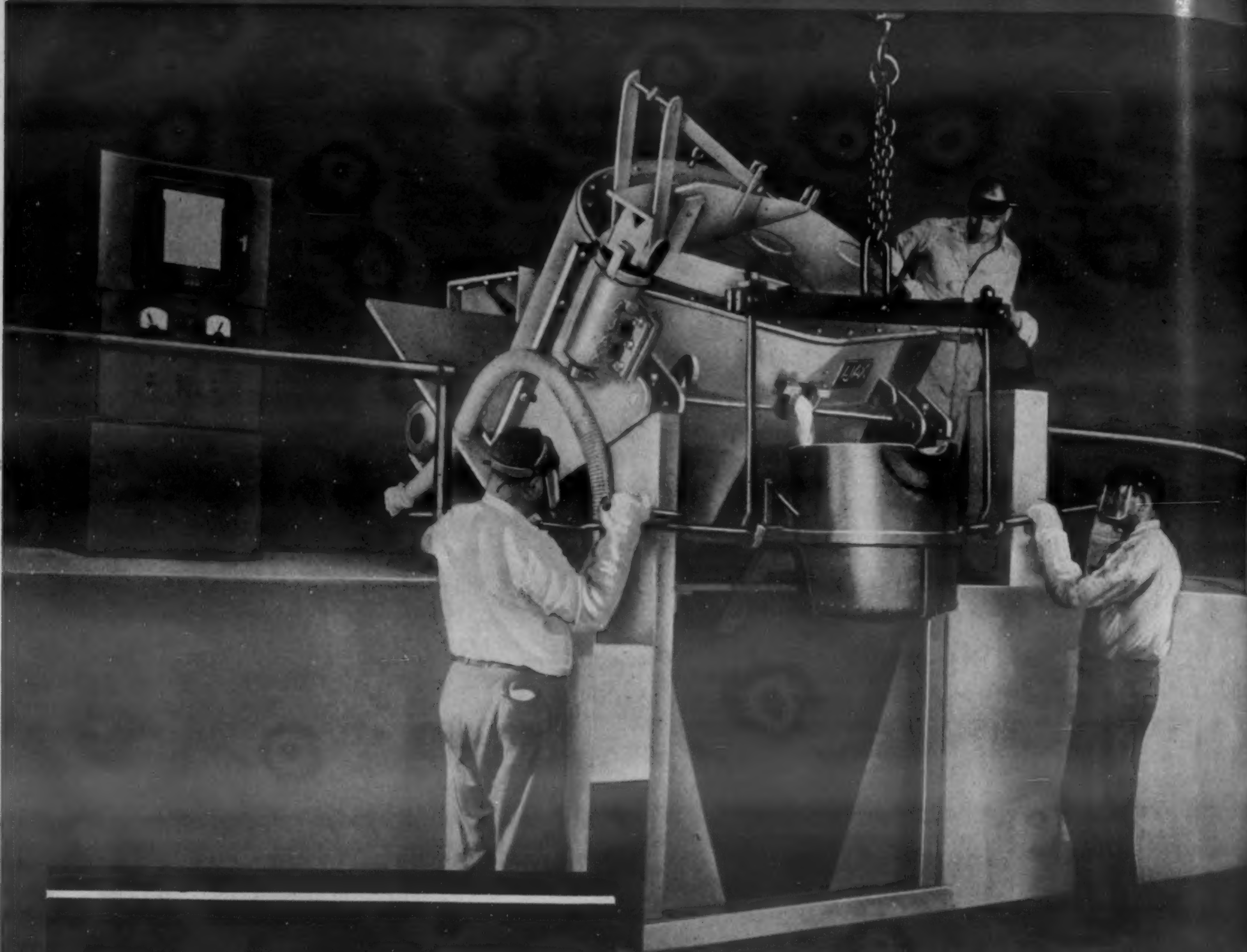
The annual dinner of the American Welding Society is to be held at the Ambassador Hotel Thursday evening, at which time society medals and prizes will be presented. Following the dinner Dr. W. F. Hess of Rensselaer Polytechnic Institute will deliver the Adams lecture.

Metals Divisions AIME

The joint dinner of the two metals divisions of the American Institute of Mining & Metallurgical Engineers is scheduled for Tuesday evening at the Claridge Hotel. An extra feature of this group's technical session will be a lecture by William Hume-Rothery of Oxford University before the Institute of Metals Division Tuesday morning.

American Industrial Radium & X-Ray Society

Dr. Kent R. Van Horn will deliver the retiring president's address before this society at a meeting in the Seaside Hotel Thursday morning. At that session Dr. Van Horn will be given the Mehl Lecture Award.



The New AJAX 125 kw. Furnace for the Aluminum Alloy Foundry

● Especially designed for the melting of finely divided aluminum alloy particles like turnings, chips and unbaled foil. This furnace is operated on the twin coil induction principle. Oxidation losses are reduced considerably, and yields of 95% to 96% of the dry weight of the charge are obtained with this unit, in view of the rapid melting and the low temperature prevailing in the hearth during the melting operation. These units promise large savings in the recovery of aluminum alloy scrap of all kinds, in addition to all the other advantages of induction melting.

AJAX TAMA-WYATT INDUCTION MELTING FURNACE

Associate Companies: **AJAX METAL COMPANY,** Non-Ferrous Ingot Metals and Alloys for Foundry Use
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AJAX ELECTRIC CO., INC., The Ajax-Hultgren Electric Salt Bath Furnace
AJAX ELECTRIC FURNACE CORP., Ajax-Wyatt Induction Furnaces for Melting

A. L. Boegehold of the General Motors Research Laboratories is present vice-president and president elect of the American Society of Metals.

E. C. Bain, vice-president Carnegie-Illinois Steel Corp., awardee, Albert Sauveur Achievement Award.

R. E. Zimmerman, vice - president, United States Steel Corp., awardee, ASM Medal for the Advancement of Research.

Technical Program

American Society for Metals

The technical sessions of the American Society for Metals to be held in conjunction with the National Metal Congress and Exposition consist of twenty-one sessions during which more than 65 papers will be presented. In addition the popular series of Educational Lecture Courses will again cover four topics of current interest on which more than 20 papers have been prepared.

All ASM sessions will be held in Convention Hall, scene of the Exposition. The tentative program follows:

Monday, November 18

Morning — 10:00 A.M.

Session No. 1

"Development of a Turbosupercharger Bucket Alloy," by E. Epremian, General Electric Co.

"Stress Rupture and Creep Properties of Heat Resistant Gas Turbine Alloys," by Nicholas J. Grant, M.I.T.

"Structural Variations in Gas Turbine Alloys Revealed by the Stress-Rupture Test," by Nicholas J. Grant, M.I.T.

(Continued on page 1201)

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The Most Efficient and Economical System for Induction Heating

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MODEL "1400"

The Newest, Largest and Most Versatile of Induction Heating's Growing Line of

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High Frequency Electronic Generators

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INPUT . . . 220 Volts, 3 Phase, 60 Cycle, 48 KVA at 90% Power Factor.

OUTPUT . . . 1400 BTU's per minute or approximately 25 KW's at a frequency of 375,000 cycles per second. Variable output optional. A single dial permits the output of the generator to be controlled from zero to full load.

THREE PHASE SUPPLY . . . The power supply section of the unit contains a 3-phase full wave power supply which operates at 90% power factor.

2800 BTU OUTPUT . . . By operating two Model "1400" THERMONIC Induction Generators in a tandem set-up, an output of 2800 BTU's per minute or approximately 50 KW is available.

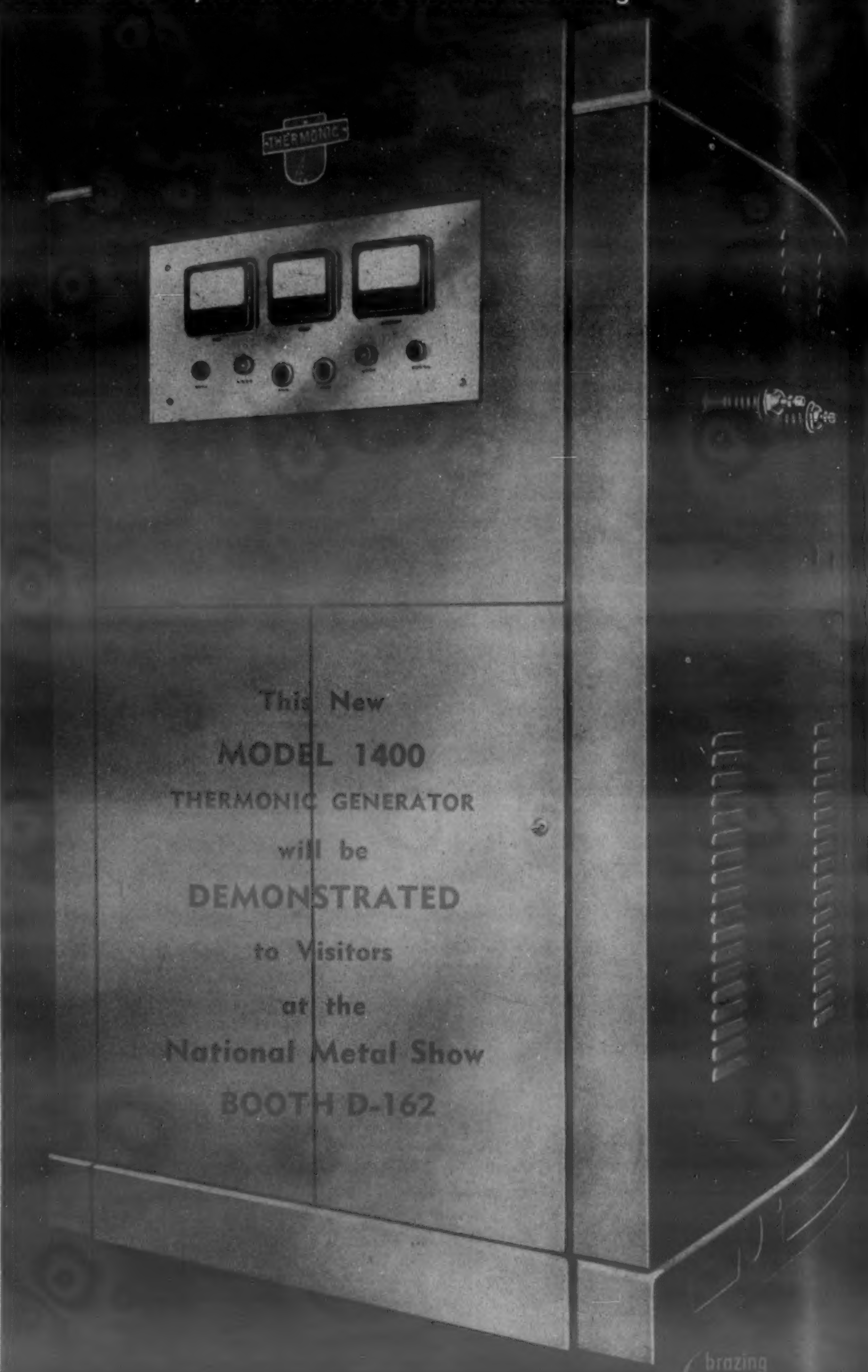
FILAMENT VOLTAGE CONTROL . . . The unit includes an automatic voltage control which regulates all filament voltages to a pre-determined value independent of line voltage changes.

TIME DELAY WATER SYSTEM . . . Incorporated in the unit, there is a new patented time delay water system. This device makes it impossible to damage the tubes by turning off the water too soon after the generator has been shut down.

SUPERVISORY CONTROL . . . The instrument panel contains pilot lights which give supervisory control on the overload relay and water system.

DIMENSIONS . . . 43" wide. 39" deep. 72½" overall height. Weight, approximately 2,000 lbs.

This new unit greatly increases the potentialities of induction heating. The members of our technical staff, therefor, now welcome the opportunity to give you the complete details. Inquiries invited!



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Largest Producers of Electronic Heat Treating Equipment for brazing, melting, hardening, forging, annealing

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 (continued from page 1199)

Session No. 2

"Some Special Metallographic Techniques for Magnesium Alloys," by P. F. George, Dow Chemical Co.

"Calculation of Press Forging Pressures and Application to Magnesium Forgings," by R. L. Dietrich and G. Ansel, Dow Chemical Co.

"Plastic Deformational Analyses of Pure Magnesium," by Louis A. Carapella and William E. Shaw, Mellon Institute of Industrial Research.

Session No. 3

"Stability of Austenite in Stainless Steels," by C. B. Post and W. S. Eberly, Carpenter Steel Co.

"The Cold Work Hardening Properties of Stainless Steel in Compression," by F. K. Bloom, G. N. Goller and P. G. Mabus, Rustless Iron & Steel Div., American Rolling Mill Co.

"Quantitative Evaluation of Intergranular Corrosion of 18:8 Ti," by F. J. Phillips, Carnegie-Illinois Steel Corp.

Afternoon — 2:00 P.M.

Session No. 1

"Ladle Deoxidation of Killed Steel With Silicon Carbide and Its Effect on Physical Properties and Hardenability," by E. A. Loria and A. P. Thompson, Mellon Institute of Industrial Research.

"The Physical Chemistry of Acid Refining Process," by Yap Chu-Phay, National Resources Commission of China.

"The Chromium-Oxygen Equilibrium in Liquid Iron," by Hsin-Min Chen, Carnegie-Illinois Steel Corp., and John Chipman, M.I.T.

Session No. 2

"The Precipitation Heat Treatment of Work Hardened 61S-W Aluminum Alloy," by J. J. Warga, Kaiser Fleetwings.

"Constitution of the System Indium-Tin," by F. N. Rhines, W. M. Urquhart and H. R. Hoge, Carnegie Institute of Tech.

"New Wrought Zinc Alloys Containing Small Amounts of Beryllium," by R. H. Harrington, General Electric Co.

Tuesday, November 19

Morning — 10:00 A.M.

Session No. 1

"Bainitic Hardening of High Speed Steel," by C. K. Baer and P. Payson, Crucible Steel Co. of America.

"The Tempering of High-Alloy Tool Steels," by G. A. Roberts, A. H. Grobe and C. F. Moersch, Jr., Vanadium-Alloys.

"Changes in Size and Toughness of High-Carbon High-Chromium Steels Due to Subzero Treatments," by L. E. Gippert and G. M. Butler, Jr., Allegheny Ludlum Steel Corp.

Session No. 2

"Pole Figures of the Effect of Some Cold Rolling Mill Variables on Low-Carbon Steel," by J. K. Wood, Jr., Penna. State College.

"X-Ray Study of the Effect of High Hydrastatic Pressures on the Perfection of Crystals," by Louis Rosen.

"A Periodic Chart for Metallurgists," by Carl A. Zapffe.

Session No. 3

"Formation and Transformation Studies of Iron-Carbon Powder Alloys," by John F. Kahles, Univ. of Cincinnati.

"Carbon Concentration Control," by E. G. de Coriolis, O. E. Cullen and Jack Huebler, Surface Combustion Corp.

"Decarburization During Annealing of Malleable Iron," by H. A. Schwartz and James Hedburg, National Malleable and Steel Castings Co.

Afternoon — 2:00 P.M.

Session No. 1

"A Rapid Method for Accurate Yield Stress Determination Without Stress-Strain Curves," by L. J. Ebert, M. L. Fried and A. R. Toole, Case School of Applied Science.

"Folding in the Cupping Operation," by W. M. Baldwin, Jr., and T. S. Howald, Chase Brass & Copper Co.

"Bearing Properties of 24S-T Sheet, and Shear Strength of 24S-T Rivets at Elevated Temperatures," by A. E. Flanigan, L. F. Tedson and J. E. Dorn, Univ. of Calif.

Session No. 2

"Development of Temper Brittleness in Alloy Steels," by W. S. Pellini, American Brake Shoe Co., and B. R. Queneau, Carnegie-Illinois Steel Corp.

"A Metallographic Etchant to Reveal Temper Brittleness in Steel," by J. B. Cohen, A. Hurlich and M. Jacobson, Watertown Arsenal.

"Electrolytic Conductivity as a Method for Studying Electronic Transitions in Elements—Application to Iron, Nickel and Cobalt," by W. R. Ham and C. H. Samans, American Optical Co.

Wednesday, November 20

Morning — 10:00 A.M.

A.S.M. Annual Meeting

Edward de Mille Campbell Memorial Lecture, by J. B. Austin, United States Steel Corp.

Afternoon — 2:00 P.M.

Session No. 1

"Changes in Austenitic Chromium-Nickel Steels During Exposures at 1100 to 1700 F," by Peter Payson and C. H. Savage, Crucible Steel Co. of America.

"Cast Heat Resistant Alloys of the 16% Chromium, 35% Nickel Type," by H. S. Avery and N. A. Matthews, American Brake Shoe Co.

"The Apparent Influence of Grain Size on the High-Temperature Properties of Austenitic Steels," by C. L. Clark, Timken Roller Bearing Co., and J. W. Freeman, Univ. of Michigan.

Session No. 2

"A Study of Furnace Brazing as Applied to 12% Chromium Low-Carbon Steel," by T. H. Gray, Westinghouse Electric Corp.

"Stress Cracking of Electroplated Lockwashers," by K. B. Valentine, Pontiac Motor Div., General Motors Corp.

"Nondestructive Inspection of Mine Hoist Cable," by P. E. Cavanagh, Allen B. Du Mont Laboratories, Inc., and R. S. Segsworth, General Engineering Co., Ltd.

Thursday, November 21

Morning — 10:00 A.M.

Session No. 1

"The Interrupted Quench and Its Practical Aspects," by Howard E. Boyer, American Bosch Corp.

"Experimental Studies of Continuous Cooling Transformation," by C. A. Liedholm, Curtiss-Wright Corp.

"Isothermal Transformation of Austenite," by Axel Hultgren, K. Tekniska Hogskolan, Sweden.

Session No. 2

"Influence of the Strain Rate and the Stress System on the Mechanical Properties of Copper," by D. J. McAdam, Jr., G. W. Geil and D. H. Woodard, National Bureau of Standards.

"Copper-Manganese Alloys — the Properties of Cold Worked and Annealed Alloys Containing 2 to 20% Manganese," by R. S. Dean, J. R. Long, T. R. Graham and D. P. Sugden, U. S. Bureau of Mines.

"Age Hardening Copper-Cobalt-Manganese Alloys," by J. W. Fredrickson, Univ. of Utah.

Session No. 3

"Mechanical Properties of Cast Low-Alloy Steels," by Malcolm F. Hawkes, Carnegie Inst. of Technology.

"Kinetics of Solidification of Killed Steel Ingots," by J. W. Spretnak, Carnegie Inst. of Technology.

"Ingot Factors in the Production of Seamless Gun Tubes," by J. W. Spretnak, Carnegie Inst. of Tech., K. L. Fetters, Youngstown Sheet & Tube Co., and E. L. Layland, Westinghouse Electric Corp.

(Continued on page 1203)

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 (continued from page 1201)

Afternoon — 2:00 P.M.

Session No. 1

"The Measured Knoop Hardness of Hard Substances and Factors Affecting Its Determination," by Newman W. Thibault and Helen L. Nyquist, Norton Co.

"Determination of Knoop Hardness Numbers Independent of Load," by L. P. Tarasov and N. W. Thibault, Norton Co.

"Hardenability of Shallow Hardening Steels Determined by the PV Test," by B. F. Shepherd, Ingersoll-Rand Co.

Session No. 2

"The Effect of Composition on the Fatigue Strength of Decarburized Steel," by L. R. Jackson and T. E. Pochapsky, Battelle Memorial Institute.

"Transformation in Krupp-Type Carburizing Steels," by A. R. Troiano and J. E. De Moss, Univ. of Notre Dame.

"Precipitation in a Magnesium Sheet," by C. T. Haller, International Nickel Co., and C. S. Barrett, Institute for the Study of Metals, Univ. of Chicago.

Friday, November 22

Morning — 10:00 A.M.

Session No. 1

"Carburized Cases of Hypo-Eutectoid Carbon Content," by P. C. Rosenthal and G. K. Manning, Battelle Memorial Institute.

"Carbide and Oxide in Surface Zones of Carburized Alloy Steels," by Axel Hultgren and Erik Hagglund, K. Tekniska Hogskolan, Sweden.

"Hardness Testing of Metals and Alloys at Elevated Temperatures," by Frederick P. Bens, Climax Molybdenum Co. of Michigan.

Session No. 2

"The Effects of Microstructure on the Mechanical Properties of Steel," by J. H. Holloman, L. D. Jaffo, D. E. McCarthy and M. R. Norton, Watertown Arsenal.

"Metallurgical and Structural Investigation of Steel Castings for Aircraft," by L. W. Smith, and L. D. Morris, Cornell Aeronautical Laboratory.

"Factors Influencing the Pearilitic Microstructure of Annealed Hypo-Eutectoid Steel," by R. A. Grange, U. S. Steel Corp.

Session No. 3

"The Effect of Manganese on the Properties of Cast Carbon and Carbon-Molybdenum Steels," by N. A. Ziegler, W. L. Meinhart and J. R. Goldsmith, Crane Co.

"Relation of Quenching Rate and Hardenability to the Mechanical Properties of Several Heat Treated Cast Alloy Steels," by Charles R. Wilks, Howard S. Avery and Earnshaw Cook, American Brake Shoe Co.

"A Laboratory Study of Quench Cracking in Cast Alloy Steels," by M. C. Udy and K. M. Barnett, Battelle Memorial Institute.

Afternoon — 2:00 P.M.

"Practical Importance of Hydrogen in Metal-Arc Welding of Steel," by S. A. Herres, Battelle Memorial Institute.

"Effect of Composition, Heat Treatment, and Cold Work on the Hydrogen Embrittlement of Stainless Steel Wire During Cathodic Pickling," by C. A. Zapffe, Baltimore, Md., and O. George Specht, Jr., Grede Foundries.

"Acid Composition, Concentration, Temperature and Pickling Time as Factors in the Hydrogen Embrittlement of Mild Steel and Stainless Steel Wire," by C. A. Zapffe and M. Eleanor Haslem, Baltimore, Md.

"Measurement of Embrittlement During Chromium and Cadmium Electroplating and the Nature of Recovery of Plated Articles," by C. A. Zapffe and M. Eleanor Haslem, Baltimore, Md.

Four Educational Lecture Courses

The Structure of Cast Iron

Three Lectures, by Alfred Boyles, U. S. Pipe and Foundry Co.
Mon., Nov. 18, Tues., Nov. 19, Wed., Nov. 20 — 8:00 P.M.

Electronic Methods of Inspection of Metals

Eight Lectures — Five Sessions
Mon., Nov. 18, Tues., Nov. 19, Wed., Nov. 20 — 2:00 P.M.
Thurs., Nov. 21 — 3:00 P.M., Fri., Nov. 22 — 2:00 P.M.

"Electronic Methods for the Measurement of Stress in Metals (According to the Baldwin SR-4 Strain Gage)," by Henry Hamburg, Chance Vought Aircraft Co.

"Direct Spectrochemical Analysis, Photo-Electric Recording," by J. L. Saunderson, Dow Chemical Co.

"Uses of the DuMont Cyclograph for Testing of Metals," by R. S. Segsworth, General Engineering Co.

"Determination of Seams in Steels by Magnetic Analysis Equipment," by Charles Lickey, Jones & Laughlin Steel Corp.

"Electronics in Liquid Steel," by H. T. Clark, Jones & Laughlin Steel Corp.

"The Electron Microscope and Its Application to Metals," by C. S. Parrett, Carnegie Institute of Technology.

"The Sperry Reflectoscope," by E. O. Dixon, Ladish Drop Forge Co.

"The Metalsorter," by G. H. Tyne, Allied Control Co.

Physical Metallurgy of Aluminum

Five Lectures
Mon., Nov. 18, Tues., Nov. 19, Wed., Nov. 20 — 8:00 P.M.
Thurs., Nov. 21, Fri., Nov. 22 — 2:00 P.M.

"Constitution of Aluminum Alloys," by W. L. Fink.

"Metallography of Aluminum Alloys," by F. Keller.

"Commercial Cast Aluminum Alloys," by W. E. Sicha.

"Commercial Wrought Aluminum Alloys," by J. A. Nock, Jr.

"Thermal Treatments of Aluminum Alloys," by E. H. Dix, Jr.

(All members of the staff of Aluminum Co. of America)

Sleeve Bearing Metals

Six Lectures — Five Sessions
Mon., Nov. 18., Tues., Nov. 19, Wed., Nov. 20 — 3:00 P.M.
Thurs., Nov. 21, Fri., Nov. 22 — 2:00 P.M.

"Background Information," by R. W. Dayton, Battelle Memorial Institute.

"Newer Bearing Materials," by F. R. Hensel, P. R. Mallory & Co.

"Steel-Backed Bearings," by Edwin Crankshaw, Cleveland Graphite Bronze Co.

"Selection of Bearing Materials," by A. F. Underwood, General Motors Research Laboratories.

"Bearings for Extreme Service," by J. Palsulich, Wright Aeronautical Corp.

"The British Point of View," by W. H. Tait, Glacial Metal Co., Ltd.

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NOW—a practical and helpful discussion to assist you in planning your toolroom heat treating department—complete with diagrams, floor space layouts, approximate cost figures, etc. Material in this booklet is based on information gained from helping in the design of hundreds of toolrooms—plus additional information gathered from the experiences of our associate, Lindberg Steel Treating Company, who operate one of the world's largest toolroom heat treating set-ups.

IT TELLS . . .

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- ★ **How much floor space is needed.**
- ★ **How to select equipment of the proper size.**
- ★ **What auxiliary equipment is required.**
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(Nov. 18-22, 1946, Atlantic City, New Jersey)

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LINDBERG FURNACES

Technical Program

American Institute of Mining and Metallurgical Engineers

American Institute of Mining & Metallurgical Engineers Technical Sessions, luncheons and banquet are to be held at The Claridge, AIME headquarters hotel.

Iron and Steel Division

Monday, November 18

Morning — 10:00 A.M.

"German Iron Ores Yield Vanadium," by R. P. Fischer.

"Controlled Atmospheres from City Gas for the Heat Treatment of Steels," by Ivor Jenkins.

"Production of Low Sulfur Sponge Iron," by R. C. Buehl, E. P. Shoub and J. P. Riott.

Afternoon — 2:00 P.M.

"An Electrochemical Study of the Properties of Molten Slags of the Systems CaO-SiO_2 and CaO-$Al_2O_3SiO_2$," by Lo Ching Chang and Gerhard Derge.

"Oxygen in Liquid Open Hearth Steel, Oxygen Content During the Refining Period," by T. E. Brower and B. M. Larsen.

"Oxygen in Liquid Open Hearth Steel—Effect of Special Additions, Stirring Methods and Tapping," by T. E. Brower and B. M. Larsen.

Simultaneous Joint Session

"Magnesium Alloys—Oxide Films" (See Institute of Metals Div.)

Tuesday, November 19

Morning — 9:00 A.M.

Joint Technical Session with Institute of Metals Div.

"Multiaxial Stresses on Metals"—a symposium arranged by M. Gensamer.

"Mechanical Equation of State," by J. H. Holloman.

"A Statistical Theory of Fracture," by J. C. Fisher and J. H. Holloman.

"A Thermodynamic Theory of the Fracture of Metals," by E. Saibel.

Afternoon — 2:00 P.M.

Continuation of Joint Technical Session

"Work Hardening and Rupture in Metals," by L. R. Jackson.

"Comparison of Various Structural Alloy Steels by Means of the Static Notch-Bar Tensile Test," by G. Sachs, L. F. Ebert and W. F. Brown, Jr.

"Plastic Flow of Aluminum Alloy Sheet Under Combined Loads," by W. T. Lankford, J. R. Low and M. Gensamer.

"Problems in Unstable Flow under Biaxial Stresses," by W. T. Lankford and E. A. Saibel.

Wednesday, November 20

Afternoon — 2:00 P.M.

Metallography

"Hot Deformation Structures, Banding and Red-Shortness Cracks in Steel," by A. Hultgren and B. Herrlander.

"Transformation of Austenite in an Aluminum-Chromium-Molybdenum Steel," by R. A. Grange, W. S. Holt and E. T. Tkac.

"Effect of Alloys in Steel on Resistance to Tempering," by Walter Crafts and J. L. Lamont.

"Calculation of Tensile Strength and Yield Point from the Chemical Composition and Cooling Rate," by I. R. Kramer, P. D. Gorsuch and D. L. Newhouse.

"Boron in Certain Alloy Steels," by M. C. Udy and P. C. Rosenthal.

Institute of Metals Division

Monday, November 18

Morning — 10:30 A.M.

Aluminum Alloys

"Precipitation in Age Hardened Aluminum Alloys," by A. H. Geisler and F. Keller.

"Stress-Rupture and Creep Tests on Aluminum Alloy Sheet at Elevated Temperatures," by A. E. Flanagan, L. F. Tedsen and J. E. Dorn.

Afternoon — 2:00 P.M.

Magnesium Alloys — Oxide Films (Joint Session)

"Hydrogen in Magnesium Alloys," by R. S. Busk and E. G. Bobalek.

"Some Effects of Zirconium on the Extrusion Properties of Magnesium Base Alloys Containing Zinc," by J. P. Doan and G. Ansel.

"An Electron Diffraction Study of Oxide Films Formed on Fe, Co, Ni, Cr, and Cu at High Temperatures," by E. A. Gulbransen and J. W. Hickman.

"An Electron Diffraction Study of Oxide Films Formed on Alloys of Fe, Co, Ni, Cr, and Cu at High Temperatures," by E. A. Gulbransen and J. W. Hickman.

Tuesday, November 19

Morning — 9:00 A.M.

Joint Technical Session

(See Iron and Steel Division)

10:45 A.M.

1946 Institute of Metals Division Annual Lecture by Dr. William Hume-Rothery, Oxford University: *"Electrons, Atoms, Metals and Alloys."*

Afternoon — 2:00 P.M.

Joint Technical Session (Cont.)

General Session:

"Some Factors Affecting the Particle Size of Tungsten," by Bernard Kopelman.

"Spot Welding of Titanium," by R. S. Dean, J. R. Long, E. T. Hayes and D. C. Root.

"The Melting of Molybdenum in the Vacuum Arc," by R. M. Parke and J. L. Ham.

"Solubility of Hydrogen in Electrolytic Manganese and Transition Points in Electrolytic Manganese," by E. V. Potter and H. C. Lukens.

Wednesday, November 20

Afternoon — 2:00 P.M.

Copper Alloys — Metallography

"Twin Relationships in Annealed Copper Strip," by P. Coheur and C. S. Barrett.

"Twinning in Polycrystalline Magnesium," by C. S. Barrett and C. T. Haller.

"Zinc Diffusion in Alpha Brass," by A. Sonigelskas and E. O. Kirkendall.

"The Alpha Solid-Solution Area of the Copper-Manganese-Aluminum System," by R. S. Dean, J. R. Long, T. R. Graham, A. H. Roberson and C. E. Armantrout.

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Technical Program — American Welding Society

The American Welding Society will hold its 27th annual meeting in conjunction with the National Metal Congress and Exposition. There will be 24 sessions, covering 15 divisions of the welding field, at which 80 papers are scheduled for presentation. All AWS sessions are to be held at the Hotel Ambassador.

The tentative technical program follows:

Monday, November 18

Morning

Weldability

"Cracking and Ductility in the Heat-Affected Zone of Metal Arc Welds," by C. B. Voldrich, Battelle Memorial Institute.

"An Investigation of the Effect of Welding on the Transition Temperatures of Navy High-Tensile Low-Alloy Steels," by G. G. Luther, R. E. Metius, C. E. Hartbower and F. H. Laxar, Naval Research Laboratory.

"Influence of Geometrical Restraint and Temperature on the Toughness and Mode of Rupture of Structural Steel," by A. R. Anderson and A. G. Waggoner, Cramp Shipbuilding Corp.

Electrodes

"The E601X Electrode Group," by Orville T. Barnett, Metal & Thermit Corp.

"Some Recent Developments in the Manufacture of Fluxes for Automatic Submerged Arc Welding," by W. M. Cohn, Consulting Engineer and Physicist.

"Development and Application of Lime Ferritic Electrodes," by D. L. Mathias and A. P. Bunk, Metal & Thermit Corp.

Railroad

"Quantity Production of Railroad Passenger Cars by Resistance Welding," by A. M. Unger, Pullman-Standard Car Manufacturing Co.

"Locomotive Boilers—Welded Construction," by James Partington, American Locomotive Co.

"Welded Freight Car Construction," by R. L. Rex, Air Reduction.

Afternoon

"Arc Atmospheres and Underbead Cracking," by M. W. Mallett and P. J. Rieppel, Battelle Memorial Institute.

"The X-Ray Diffraction Study of the Effect of Residual Compression on the Fatigue of Notched Specimens," by J. T. Norton, D. Rosenthal and S. B. Maloof, Massachusetts Institute of Technology.

"The Weldability of Ship Steels: Effects of Travel Speed, Preheat Temperature, and Arc Power Level on Notch Toughness," by E. E. Nippes and W. F. Savage, Rensselaer Polytechnic Institute.

"Some Observations on the Weldability of High-Strength Wrought Aluminum Alloys," by W. R. Apblett, Naval Research Laboratory.

Production

"Automatic Gas Shielded Welding," by G. J. Gibson, Air Reduction Sales Co.

"Jigs and Fixtures for Automatic Fusion Welding," by L. J. Berkeley, Penn Tool & Machine Co., and E. D. Morris, Linde Air Products Co.

"Tool and Die Welding," by A. R. Butler and F. E. Kessler, Welding Equipment & Supply Co.

"Welding of Electric Apparatus," by E. F. Potter, Works Laboratory, General Electric Co.

Storage Tanks and Pressure Vessels

"Field Erected Pressure Vessels," by F. L. Plummer, Hammond Iron Works.

"Dry Seal Gas Holders, All-Welded," by Rudolf Kraus, Stacey Bros. Gas Construction Co.

"Submerged-Melt Welding in Pressure Vessel Fabrication," by N. G. Schreiner, Linde Air Products Co.

Tuesday, November 19

Morning

Research

"Computation of Cooling Time in Butt Welds," by D. Rosenthal, Massachusetts Institute of Technology.

"Effect of Peening on Residual Welding Stresses," by Paul DeGarmo, Finn Jonassen and J. L. Meriam, University of California.

"Welding of High-Strength Steels With Ferritic Electrodes," by S. A. Herres and P. E. Woodward, Watertown Arsenal Laboratory.

Resistance Welding

"Flash Welding of Concentrated Areas Up to 24 Sq. In. in S.A.E. 1020, N. E. 9440, and N. E. 8620 Steels," by D. Bruce Johnston, McPhee and Johnston.

"Resistance Welding of Spring Steel to Low-Carbon Steel," by Arthur Willink, Registered Professional Engineer.

"Design for Resistance Welding," by I. A. Crawford, Ex-Cello-O Steel Products Co.

Machinery

"The Metallurgical Effect of Flame Hardening Application," by O. M. Harrelson, Georgia School of Technology.

"The Evolution of Diesel Engine Block Weldment Designs," by J. W. Owens, Fairbanks-Morse & Co.

"Coordination of Engineering and Production in the Manufacture of Welded Products," by E. C. Brekelbaum, Harnischfeger Corp.

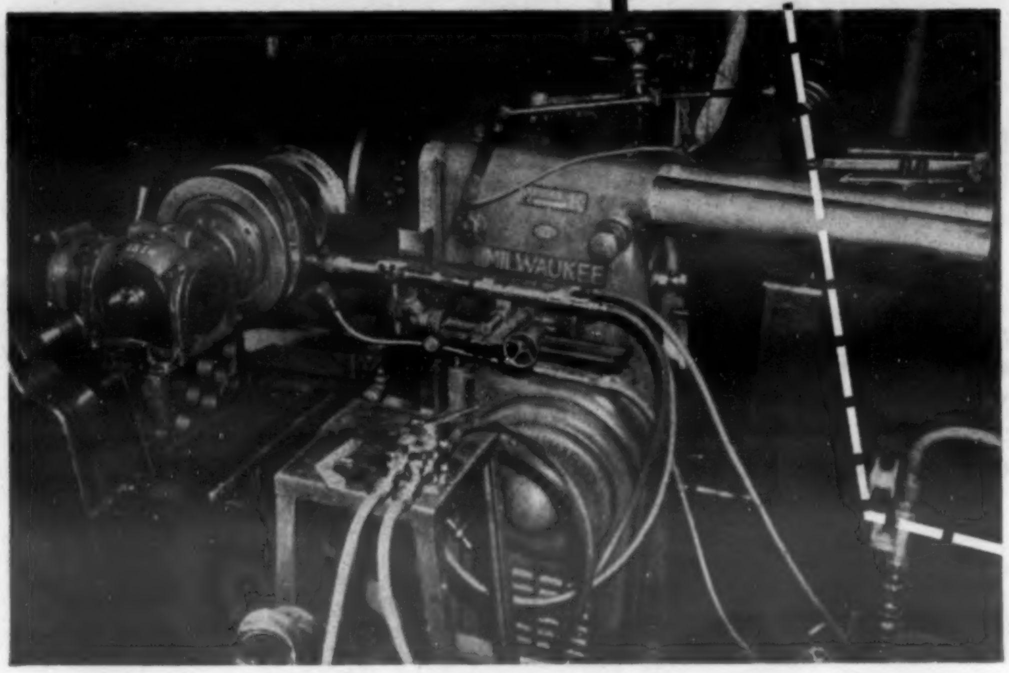
Afternoon

"Redistribution of Residual Welding Stresses by Tensile Loading Along a Unionmelt Weld Joining Two 3-Ft. by 12-Ft. by 1-In. Plates," by J. L. Meriam, E. Paul DeGarmo and Finn Jonassen, University of California.

(Continued on page 1209)

how to lengthen the life of machine tool parts

by Airco Flame Hardening



PART: Cam Track in Barrel Cam
MATERIAL: Meehanite
HARDNESS OBTAINED: 62 Rockwell "C" 86 Scl.
DEPTH OF CASE: 1/8 inch
SET-UP (Change-over) TIME: 3 hours
CYCLE TIME: 20 minutes
DISTORTION: None measurable

Performed on Kearney & Trecker 2K Universal Horizontal Milling Machine with cam-milling saddle. Standard Airco tapered cylindrical tip, flame-hardening torch, universal adjustable bracket, and accessories used.

Milling machine converted to flame hardener in 3 hours, barrel cam hardened in 20 minutes

HOW IT WAS DONE – After cam was milled, holder and torch were clamped to column face of milling machine. Both sides of cam track were flame hardened in one revolution with the identical set-up used in machining the cam. Since contours followed in hardening were identical to those in milling, uniform hardness and depth of case were achieved.

Because of mass of the barrel cam, certain extra precautions were used. The coolant was circulated through a refrigerating unit mounted at rear of machine. An auxiliary quench was used. Baffle plates deflected heat from machine and dividing-head surfaces. No measurable distortion occurred. No damage resulted to milling machine or attachments used.

This is typical of the type of equipment that can be flame hardened to extend service life. Flame treatment does not effect properties of the core – wear-resisting surfaces are produced while still retaining the toughness and ductility of core material. Distortion is so negligible that hardening is normally done after finish grinding.

Airco flame treating can be economically applied to single parts or to units in mass production. Normally standard machine tools, with standard Airco oxyacetylene equipment, are all that is needed.

If you are making or using parts that will give longer life when surface hardened, fill in and mail the coupon for copies of Oxyacetylene Flame Hardening Handbook and Flame Hardening Apparatus Catalog No. 90. Air Reduction, General Offices, 60 East 42nd Street, New York 17, N. Y. In Texas: Magnolia Airco Gas Products Company, General Offices: Houston 1, Texas. Represented internationally by Airco Export Corporation.

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"*Welding Research as Applied in the South,*" by W. W. Austin, Jr., and E. N. Kemler, Southern Research Institute.
"*Welding of Hardenable Steels With High-Alloy (Austenitic) Electrodes,*" by Miss A. M. Turkalo and Capt. S. A. Herres, Watertown Arsenal Laboratory.
"*An Investigation of the Phenomenon of Cleavage-Type Fractures in Low-Alloy Structural Ship Steels,*" by H. J. Gershenow and G. G. Luther, Naval Research Laboratory.

Resistance Welding
"*Resistance Welding With Storage Batteries,*" by J. D. Gordon, Progressive Welder Co.
"*Thermal Resistance of Metal Contacts,*" by W. B. Kouwenhoven, Dean, School of Engineering, and J. H. Potter, Johns Hopkins University.
"*A Summary of the Spot Welding of High-Tensile Carbon and Low-Alloy Steels,*" by W. D. Doty and W. J. Childs, Rensselaer Polytechnic Institute.

Shipbuilding
"*Some Problems of Welding Design and Fabrication of Steel Floating Dry Docks,*" by A. Amirikian, Bureau of Yards and Docks, Navy Department.
"*Control of Welding Stresses by Welding Sequence,*" by Paul Field, Shipbuilding Div., Bethlehem Steel Co.
"*Discussion—Final Report of the Board to Investigate the Design and Methods of Construction of Welded Steel Merchant Vessels,*" by Comdr. R. D. Schmidtman, J. Lyell Wilson and Finn Jonassen, Members of the Sub-Board.

Wednesday, November 20

Morning

Cutting
"*Automatic Oxyacetylene Operations,*" by S. D. Baumer, Air Reduction Sales Co.
"*Heavy Cutting Applications in Foundry and Steel Mill,*" by R. S. Babcock, Linde Air Products Co.
"*Stainless Steel Cutting,*" by Howard Hughey, Air Reduction Sales Co.

Resistance Welding
"*Additional Timing Period of New Motor-Driven Control Increases Gun Welder Speed,*" by H. I. Stanback, Square D Co.
"*Radiography and the Fatigue Strength of Spot Welds in Aluminum Alloys,*" by Robert C. McMaster and H. J. Grover, Battelle Memorial Institute.
"*Resistance Welding*"—A General Electric film to be shown by L. D. T. Berg, General Electric Co.

Structural
"*H-Section Welded Trusses,*" by A. T. Waidelich, Austin Co.
"*Welded Pier Leg, Shear Leg and Trolley of a 15-Ton Ore Bridge,*" by G. F. Wolfe, Dravo Corp.
"*Recent Trends in Concepts of Design for Welded Steel Structures,*" by LaMotte Grover, Air Reduction Sales Co.

Afternoon

Resistance Welding
"*Choice of Cable and Transformer Size for Portable Spot Welder,*" by Myron Zucker, MacKworth G. Rees, Inc.
"*Three-Phase Balanced Load Resistance Welding Machines,*" by Mario Sciaky, Sciaky Brothers.
"*Flash Welding of Hard Drawn High-Carbon Steel Wire,*" by R. W. Bennett and R. D. Williams, Battelle Memorial Institute.
"*Selecting Spot Welding Schedules for Low-Carbon Steel,*" by Julius Heuschkel, Westinghouse Electric Laboratories.

Cutting
"*Arc-Oxygen Cutting on the Surface and Under Water,*" by Charles Kandel, Craftsweld Equipment Corp.
"*Powder Cutting and Scarfing of Oxidation Resistant Materials,*" by D. H. Fleming, Linde Air Products Co.
"*Some Recent Canadian Contributions to Oxygen Cutting, and Film 'No Keener Blade,'*" by R. A. Dunn, Canadian Liquid Air Co., Ltd.
"*Oxygen Cutting of Steel at Elevated Temperatures,*" by J. F. Kiernan and J. S. Sohn, Air Reduction Sales Co.

Welding Alloy Steels
"*Investigation of the Weldability of Copper-Bearing Steels,*" by N. H. Keyser and C. H. Lorig, Battelle Memorial Institute.
"*The Control of Weld Hot Cracking in Nickel-Chromium-Iron Alloys,*" by T. E. Kihlgren and C. E. Lacy, International Nickel Co., Research Laboratory.
"*The Development and Applications of High-Strength Welding Quality Alloy Steels,*" by H. L. Miller, Republic Steel Corp.
"*Navy-E. E. S. Method for Determining the Applicable Welding Procedures for Steels,*" by Bela Ronay, U. S. Naval Engineering Experiment Station.

Thursday, November 21

Morning

"*Open Butt Oxyacetylene Compression Welding,*" by H. H. Chiswik, Air Reduction Sales Co.
"*Pressure Welding of Low-Alloy Steels and Some Nonferrous Alloys,*" by K. H. Koopman, Union Carbide & Carbon Research Laboratories, Inc.
"*Pressure Welding Propeller Hubs and Stainless Steel Rings,*" by George Motherwell, Wyman-Gordon Co., and C. J. Burch, Linde Air Products Co.
"*Pressure Gas Welding of Alloy Steel Tubing,*" by Z. L. Zambrow and R. D. Williams, Battelle Memorial Institute.

Aircraft
"*Design and Production Control Silver Alloy Brazed Joints in Aircraft Structures,*" by H. A. Smith and P. A. Koerner, Beech Aircraft Co.
"*Resistance Welding Test Methods Used to Maintain Quality in the Manufacture of the 140 Jet Engine,*" by P. G. Parks, Solar Aircraft Co.
"*Welding Problems in Jet Propulsion—Stainless Steel,*" by E. J. DeWitt and Mr. Lammers, Wallace Supplies Mfg. Co.

Hard Facing
"*Repairing Contractors and Steel Mill Equipment with Manganese Application Bars,*" by L. A. Davis, Manganal Div., Stulz Sickles Co.
"*How to Select Wear Resisting Alloys for Welding,*" by J. A. Cunningham, J. A. Cunningham Equipment, Inc.
"*Microstructure of Hard Facing Alloys,*" by H. W. Sharp, Stoody Co.
"*Composite Construction by Building Up Surfaces with Submerged-Melt Welding,*" by J. E. Taylerson, Linde Air Products Co.

Friday, November 22

Morning

High Alloys
"*An Attempt to Select A Suitable Specimen for the Study of Corrosion Cracking in 18:8 Steel,*" by D. S. McKinney, Carnegie Institute of Technology.
"*Welding and Other Fabrication Methods for Hastelloy Alloys,*" by C. G. Chisholm, Haynes Stellite Co.
"*Effect of Alloying Elements on the Tensile Properties of 25-20 Weld Metal,*" by H. C. Campbell and R. D. Thomas, Jr., Arcos Corp.

Miscellaneous
"*The Arc Welding of Cast Iron With Nickel Electrodes,*" by T. E. Kihlgren and L. C. Minard, International Nickel Co., Research Laboratory.
"*Fabricating Pressure Vessels of High-Tensile Steels,*" by E. C. Chapman and R. E. Lorentz, Jr., Combustion Engineering Co.
"*Static and Fatigue Tests of Arc Welded Aluminum Alloy 61S-T Plate,*" by E. C. Hartmann, Marshall Holt and A. N. Zamboky, Aluminum Research Laboratories.
"*Submerged-Melt Welding of Corrosion Resisting Metals,*" by H. J. Roberts, Linde Air Products Co., and R. J. Anderson, Dominion Oxygen Co., Ltd.
"*Production Applications of Inert-Gas Shielded Arc Welding,*" by H. T. Herbst, Linde Air Products Co.
"*A New Semiautomatic Arc Welding Process,*" by J. M. Tyrner, Air Reduction Sales Co.

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Technical Program

American Industrial Radium & X-Ray Society

During the week of the American Metal Congress, this society will hold its Sixth Annual Meeting, starting Nov. 20 and concluding Nov. 22. Headquarters and technical sessions are scheduled for the Seaside Hotel. The program:

Wednesday, November 20

Morning — 9:30 A.M.

"Quantitative Measurements by Controlled Process Film of Two Million Volt X-Radiation," by Donald T. O'Connor, Naval Ordnance Lab.

"Quantitative Relations Between the Photographic Response of Typical X-Ray Films and the Quality of Radiation," by Drs. Victor Hicks and H. W. Hoerlin, Ansco.

"Sliding Scales to Increase the Usefulness of Radiographic Exposure Charts," by Dr. H. E. Seemann and G. E. Corney, Eastman Kodak Co.

"Applications of G-M Counters to Measurement of X-Ray and Gamma Ray Intensities," by Dr. Herbert Friedman, Naval Research Lab.

Afternoon — 2:00 P.M.

"Design, Manufacture and Inspection of Welded Fabrications," by G. H. Campbell, A. O. Smith Corp.

"X-Ray Inspection of Rocket Propellants," by J. E. Watkins, General Electric X-Ray.

"Radiography of Heavy Radioactive Materials," by Dr. G. H. Tenney, Los Alamos Project.

"Gamma Ray Radiography in a Small Steel Foundry," by R. A. Willey, Commercial Steel Casting Co.

Thursday, November 21

Morning — 9:30 A.M.

"A Study of the Microstructure of Some Nonferrous Alloys by Means of Microradiography," by Louis Conant, Lithaloys Corp.

"X-Ray and Optical Micrography as Essentials to Correlation of Radiographic Appearance with the Serviceability of Metal Parts," by Dr. L. W. Ball, Naval Ordnance Lab.

"Microscopy and Analysis with Electrons," by Dr. James Hillier, Radio Corp. of America.

"Short Source-Object-Distance Exposure Techniques in Spotweld Radiography," by Dr. R. C. McMaster, Battelle Memorial Institute.

Afternoon — 2:00 P.M.

Annual Meeting

"Photographic Aspects of Industrial Radiography," the 1946 Mehl Lecture, by Dr. H. E. Seemann, Eastman Kodak Co.

Friday, November 22

Morning — 9:30 A.M.

"Logarithmic Step-Tablet for X-Rays," by G. E. Corney, Eastman Kodak Co.

"Further Studies of High Voltage Radiography," by E. D. Trout, General Electric X-Ray Corp.

"Radiographic Specifications, Their Nature, Purpose and Current Revisions," by J. J. Pierce, Naval Ordnance Lab.

Afternoon — 2:00 P.M.

"Spectrographic Analysis of Cartridge Brass," by M. M. White, Willys-Overland Motors, Inc.

"Proof Loading—An Essential Nondestructive Test," by J. C. New, Naval Ordnance Lab.

"Analysis of Drillings and Chips by Sintering Pellets of the Material," by M. M. White, Willys-Overland Motors, Inc.

"Testing Metals of Internal Discontinuities with Supersonic Echoes," by J. W. Dice, Sperry Products, Inc.

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List of Exhibitors

As usual, one of the most interesting features of the National Metal Congress will be the Exposition in which more than 350 suppliers of materials, equipment and services show their latest offerings. Published here is the list of exhibitors, complete, with the exception of those companies to whom space was assigned late.

Exhibitor	Booth
Acme Electric Welder Co.	G 224
Acme Tool Co.	B 232
Acro Welder Mfg. Co., Inc.	G 224
Aircraft Screw Products Co., Inc.	B 202
Air Reduction Sales Co.	A 152
Ajax Electric Co., Inc.	B 155
Ajax Electrothermic Corp.	B 147
Allis-Chalmers Mfg. Co.	C 251
Alox Corp.	A 163
Alvey-Ferguson Co., The	A 230
American Emblem Co.	H 176
American Foundry Equipment Co.	B 115
American Gas Association	G 169
American Gas Furnace Co.	G 169
American Machinist	F 169
American Metal Market	H 227
American Photocopy Equipment Co.	J 232
American Smelting & Refining Co. (Federated Metals Div.)	E 178
American Society for Metals	F 181
American Society for Metals (New Jersey Chapter)	D 224
American Steel Castings Co.	A 109
American Technical Society	H 224
American Welding Society	D 180
Ampco Metal, Inc.	B 214
Anderson Oil Co., F. E.	E 232
Anderson & Sons	A 173
Arcos Corp.	A 115
Atlas Fence Co.	G 207
Austenal Laboratories, Inc.	C 224
Aviation Maintenance	D 210
	Booth
Babcock & Wilcox Co., The (Refractories Div.)	E 143
Baird Associates	F 247
Baker & Co., Inc.	C 225
Baldwin Locomotive Works (Eddystone Div.)	G 115
Barrett-Cravens Co.	B 169
Bastian-Blessing Co., The	E 120
Bausch & Lomb Optical Co.	B 152
Bergen Precision Castings, Inc.	C 162
Better Finishes & Coatings, Inc.	A 158
Black Drill Co.	C 109
Blakeslee & Co., G. S.	D 205
Bowser, Inc. (Refrigeration Div.)	G 238
Bristol Co., The	C 142
Brown Instrument Co.	B 105
Bruning Co., Inc., Charles	G 142
Brush Beryllium Co.	G 214
Bryant Heater Co.	G 169
Buehler, Ltd.	D 119
Burkay Co.	B 173
By-Products Steel Corp.	D 155
	Booth
Cambridge Wire Cloth Co.	F 210
Canadian Radium & Uranium Corp.	F 209
Carbomatic Corp.	G 169
Carpenter Steel Co., The	C 169
Central Scientific Co.	B 109
Champion Rivet Co.	F 142
Chaves Dental Instrument Corp.	F 246
Cherry Rivet Co.	B 108
Climax Molybdenum Co.	H 151
Commerce Pattern Foundry & Machine Co.	E 204
Conover-Mast Corp.	D 210
Continental Industrial Engineers, Inc.	G 169
Crown Rheostat & Supply Co.	E 157
Crucible Steel Co. of America	E 147
	Booth
DCMT Die Casting Machine Tool Corp.	C 131
Delaware Tool Steel Corp.	B 180
Dempsey Industrial Furnace Corp.	B 132
Denison Engineering Co.	F 135
deSanno & Son, Inc., A. P.	A 181
Detroit Testing Machine Co.	B 158
Diamond Machine Tool Co.	H 246
Die Casting	F 238
Dietert Co., Harry W.	C 120
Diversey Corp., The	B 143
DoAll Co., The	B 139
Donovan Co.	G 211
Drever Co.	C 229
Driver Co., Wilbur B.	E 238
DuMont Laboratories, Allen B.	E 221
Duraloy Co., The	F 176
	Booth
Eastern Stainless Steel Corp.	B 185
East Shore Machine Products Co.	I 232
Eastman Kodak Co.	C 155
Ecco High Frequency Corp.	A 133
Eclipse Fuel Engineering Co.	G 169
Eisler Engineering Co.	F 227
Electric Furnace Co., The	D 169
Electroloy Co., Inc., The	G 224
Elox Corp.	F 158
Empire Steel Castings, Inc.	D 238
Eutectic Welding Alloys Corp.	A 180 & G 103
Expert Welding Machine Co.	F 229
	Booth
Fab-Weld Corp.	G 205
Federal Machine & Welder Co.	F 125
Fen Machine Co.	F 237
Finnell System, Inc.	E 215
Force & Co., Wm. A.	E 239
Foundry, The	A 105
Foxboro Co., The	B 142
Frontier Bronze Corp.	E 237
	Booth
Gamma Instrument Co., Inc.	H 143
Garrett Co., George K.	A 237
Gas Machinery Co.	G 169
Gehnrich & Gehnrich, Inc.	G 169
General Alloys Co.	D 109
General Aniline & Film Corp.	F 204
General Electric Co.	H 139
General Electric X-ray Corp.	H 139
Goodrich Co., The B. F.	G 173
Goodwin Co.	I 232
Gordon Electronics, Inc.	F 134
Gray-Mills Corp.	E 210
Grobet File Co. of America	B 238
Gulf Oil Corp.	D 108
	Booth
H & H Research Co.	B 232
Hager & Son, E. F.	E 227
Hammond Machinery Builders, Inc.	A 138
Handy & Harman	F 147
Harnischfeger Corp.	D 175
Hauck Manufacturing Co.	H 165
Hayes, Inc., C. I.	E 250
Heller Brothers Co.	D 227
Hevi Duty Electric Co.	E 142
Hitchcock Publishing Co.	I 228
Holden Co., The A. F.	D 125
Holliday & Co., W. J.	G 119
Hollup Corp.	E 119
Hones, Inc., Charles A.	G 169
Houghton & Co., E. F.	D 115
Huppert Co., K. H.	C 173

Booth

Illinois Testing Laboratories, Inc. ....A 245
Induction Heating Corp. ....D 162
Industrial Bulletin ....G 210
Industrial Press, The ....B 246
Industrial Heating ....B 208
Industrial Publishing Co., The ....F 238
Industrial Radiography ....B 204
Industrial Tape Corp. ....A 224
Industry & Welding ....F 238
Instrument Specialties Co., Inc. ....D 134
Intercontinental Engineers ....G 169
International Nickel Co. ....Stage
Iron Age, The ....A 142

Booth

Jackson Products ....B 220
Janney Cylinder Co. ....D 209
Jessop Steel Co. ....C 180
Johnson Fuller Co. ....B 162
Jones Co., C. Walker ....B 177
Jones & Laughlin Steel Corp. ....A 132
Joslyn Mfg. & Supply Co. ....C 147

Booth

Kemp Mfg. Co., C. M. ....G 169
Kerkling & Co. ....I 224
Kerr Manufacturing Co. ....B 237
Kewaunee Mfg. Co. ....I 233
King Co., Andrew ....E 162
Knu-Vise, Inc. ....I 226
Kolene Corp. ....J 233
Krieg Co., Charles W. ....F 180
Krouse Testing Machine Co. ....D 245
Kux Machine Co. ....D 237

Booth

Lancaster Iron Works ....C 238
Latrobe Electric Steel Co. ....E 169
Lea Manufacturing Co. ....G 232
Lead Industries Assoc. ....B 226
Leeds & Northrup Co. ....A 122
Lepel High Frequency Laboratories, Inc. ....G 105
Lester-Phoenix Co. ....G 146
Lincoln Electric Co. ....E 139
Lincoln Engineering Co. ....D 246
Lindberg Engineering Co. ....D 139
Lobdell Co. ....B 236
Lukens Steel Co. ....D 155
Lukenweld, Inc. ....D 155

Booth

Maas & Waldstein Co. ....G 177
Mabor Co. ....F 215
Machine Design ....A 105
Machine Tool Blue Book ....I 228
Machinery ....B 246
Magnaflux Corp. ....D 176
Magnesium Association, The ....G 108
Magnetic Analysis Corp. ....F 245
Mahr Manufacturing Co. ....C 176
Malleable Founders' Society ....G 215
Mallory & Co., Inc., P. R. ....G 228
Martindale Electric Co., The ....E 229
Materials & Methods ....C 181
McAleer Manufacturing Co. ....A 137
McGraw-Hill Publishing Co. ....F 169
McIntyre Co., The ....B 245
McKay Co., The ....F 220
Meehanite Metal Corp. ....E 153
Metal Finishing ....F 214
Metal Finishing Publishing Co. ....F 214
Metal Finishing Service ....D 236
Metal Industries Catalog ....C 181
Metal Progress ....F 181
Metal & Thermit Corp. ....F 153
Metals and Alloys ....C 181
Metals Review ....F 181
Metlab Co. ....C 158
Michiana Products Corp. ....G 109
Michigan Steel Casting Co. ....G 125
Mid-Continental Metal Products Co. G 169
Mid-States Equipment Corp. ....D 138
Mill & Factory ....D 210
Mine Safety Appliances Co. ....B 119
Minneapolis-Honeywell Regulator Co. ....B 105
Miskella Infra-Red Co. ....A 235
Modern Metals ....A 205
Molybdenum Corp. of America ......D 143
Motch & Merryweather Machinery Co., The ....C 232
Multi-Hydromatic Welding & Mfg. Co. ....G 224

Booth

National Cylinder Gas Co. ....E 119
National Diamond Laboratory ....F 240
National Electric Welding Machines Co. ....G 224
National Industrial Publishing Co. ..B 208
National Pneumatic Co. ....D 249
Nelson Sales Corp. ....E 224
New England Auto Products Corp. ..E 245
New Equipment Digest ....A 105
North American Philips Company, Inc. ....F 138

Booth

Oakite Products, Inc. ....H 159
Ohio Carbon Co., The ....E 209
Ohio Crankshaft Co., The ....F 179
Olsen Testing Machine Co., Tinius ..F 109
O'Neil-Irwin Mfg. Co. ....G 185
Ozalid ....F 204

Booth

Pacific Northwest ....G 221
Pangborn Corp. ....H 173
Park Chemical Co. ....C 143
Penton Publishing Co., The ....A 105
Peters-Dalton, Inc. ....H 232
Phillips Manufacturing Co. ....D 174
Physicists Research Co. ....A 143
Picker X-Ray Corp. ....A 159
Pines Engineering Co., Inc. ....G 225
Plant Purchasing Directory ....D 210
Potts Co., Horace T. ....C 163
Powder Weld, Inc. ....A 209
Power-Pak Floor Machine Co. ....G 203
Precision Shapes, Inc. ....D 229
Precision Welder & Machine Co. ....G 224
Product Engineering ....F 169
Progressive Welder Co. ....J 220
Pulmosan Safety Equipment Corp. ..C 159
Purchasing ....D 210
Purdy Co., Inc., A. R. ....H 120
Pyrometer Instrument Co., The ....B 136

Booth

Radio Corp. of America ....A 114
Radium Chemical Co., Inc. ....A 119
Ransburg Co., Harper J. ....A 170
Ransohoff, Inc., N. ....C 245
Ransome Machinery Co. ....A 125
Rapids-Standard Co., Inc., The ....A 155
Raytheon Manufacturing Co. ....D 179
Ready-Power Co., The ....G 246
Reinhold Publishing Corp. ....C 181
Resistance Welder Corp. ....G 224
Resistance Welder Manufacturers Assn. ....G 224
Revista Industrial ....A 105
Rex Welder & Engineering Co. ......G 224
Rhode Island Tool Co. ....A 211
Richards Co., J. A. ....H 229
Roberts Rubber Co., Weldon ....E 249
Roebling's Sons Co., John A. ....H 155

Booth

Safety Clothing & Equipment Co. ....E 228
Salem Engineering Co. ....C 139
Scherr Co., Inc., George ....F 158
Sciaky Bros., Inc. ....E 22[illegible]
Scientific Electric Div. ....A 22[illegible]
"S" Corrugated Quenched Gap Co. ..A 22[illegible]
Scott & Son, Inc., C. U. ....B 154
Seal-Peel, Inc. ....F 168
Selas Corp. of America ....G 169
Sentry Co., The ....H 141
Sheffield Corp. ....H 234
Sheldon Machine Co., Inc. ....A 18[illegible]
Shell Oil Co., Inc. ....G 233
Sherman & Co. ....H 172
Smith Corp., A. O. ....B 173
S-M-S Corp. ....G 224
Solvental Chemical Products, Inc. ....E 179
South Bend Lathe Works ....D 228
Sparkler Manufacturing Co. ....F 228
Specialty Equipment & Machinery Corp. ....D 250
Spencer Turbine Co., The ....E 158
Standard Oil Co. of New Jersey ....C 105
Stearns-Roger Mfg. Co., The ....H 180
Steel ....A 105
Stevens & Co., C. H. ....A 215
Stoody Co. ....F 161
Stokes Machine Co., F. J. ....H 10[illegible]
Stuart Oil Co., Ltd., D. A. ....D 142
Submergent Alloys Corp. ....G 181
Sunbeam-Stewart Industrial Furnace Co. ....D 163
Sun Oil Co. ....F 105
Sunbeam Corp. ....D 163
Super Tool Co. ....A 129
Superior Tube Co. ....E 109
Surface Combustion Corp. ....G 169
Swift Electric Welder Co. ....G 224
Synthane Corp. ....C 209

Booth

Taylor-Hall Welding Corp. ....G 224
Taylor-Winfield Corp., The ....G 229
Technical Publishing Co. ....F 238
Tempil Corp. ....C 108
Thermogen Corp. ....C 246
Thomson Electric Welder Co. ....G 224
Tide Water Associated Oil Co. ....B 181
Tinnerman Products, Inc. ....B 163
Torit Manufacturing Co. ....B 176
Trent Tube Manufacturing Co. ....A 177
Turney & Beale ....B 108

Booth

Udylite Corp., The ....G 141
Union Steel Products Co. ....H 177
Union Stop-Fire Corp. ....D 220
U. S. Hoffman Machinery Corp. ......H 225
Universal-Cyclops Steel Corp. ....A 169
Upton Electric Furnace Div. ....E 204

Booth

Vacu-Blast Co., The ....F 226
Vanadium-Alloys Steel Co. ....F 143
Vapor Blast Mfg. Co. ....F 235
Victor Equipment Co. ....F 232

Booth

Waldes Kohinoor, Inc. ....A 147
Wall Colmonoy Corp. ....G 220
War Assets Administration ....A 208
Weiger Weed & Co. ....G 224
Welding Encyclopedia ....F 169
Welding Engineer ....F 169
Welding Machines Mfg. Co. ....G 224
Welding Sales & Engineering Co. ..G 224
Weltronic Co. ....F 224
Westinghouse Electric Corp. ....C 125
Wheelco Instruments Co. ....F 108
Wilson Mechanical Instrument Co., Inc. ....B 159
Wood Products Corp., J. R. ....G 245

Booth

Yale & Towne Mfg. Co., The ....D 147

CONTENTS NOTED

A monthly department dedicated as a forum for the interchange of ideas between readers and editors. All readers are urged to take advantage of this space and participate in the discussions presented.

e Year Later

the Editor:

At the time you changed the name METALS AND ALLOYS to MATE-LS & METHODS, I remember I pressed my personal opinion that th such a change in the title, MET-S AND ALLOYS, which I esteemed much, might change its editorial licy. You see I was afraid that less d less space would be allotted to e metals, a field in which I am so erested. I am glad to admit that parently I was wrong. MATERIALS METHODS not only continues to be useful as METALS AND ALLOYS s been in the past, but I believe that increase in value of this magazine, such were possible, is to be noted. nly a few days ago I received the est issue of MATERIALS & METH-ps, and I was much impressed with t only the selection of timely ar-cles, but also with the presentation the valuable data.

It just occurred to me that you ight wish to hear from a constant d longtime reader of your publi-tion on the above subject.

V. N. Krivobok

ew York, N. Y.

We appreciate the comment of r. Krivobok and are happy to see at, to this reader at least, our ob-ctives in changing the name of this ublication were met. As was stated that time — October 1945 — we ought primarily to change our name ore properly to show the exact field we are attempting to cover and more clearly to describe the type of editorial content we have presented for several years.—The Editors.

In Defense of Arc Welding

To the Editor:

Arc welding has been of decisive importance to America. Arc welding did more than most other manufacturing process in the producing of the tools of war during World War II. Arc welding has produced a record for reliability in billions of welds, made over many years, that is unmatched by any other manufacturing process, yet arc welding is being attacked in a way which is tremendously handicapping its application, and promises still more to interfere with its future use.

This attack is aimed not at the process, as such. It is obvious such tactics would fail. The attack consists in throwing suspicion on the process by writing into specifications expensive and impractical tests which have little to do with the excellence of the weld. Most of them have to do with infinitesimal variations of no possible importance, but of great cost. The attack has already eliminated the economic use in many proper applications. If continued, it will soon eliminate many others.

We see, for instance, the ruling that welds must be X-rayed, which increases the cost by several times, yet the commercially welded joint is always of greater strength than the parent metal and is tremendously stronger than any riveted joint, where X-raying never has been suggested.

We see riveted joints which are made tight by caulking. This process is accepted without question. The resulting undercoat is enormous, yet a welding undercut that is infinitesimal is frequently made the reason for rejection of welds.

We see welds chipped out, rewelded, and welded vessels rejected because of trifling defects such as infinitesimal porosity either on the surface or beneath, yet parent metal in the same structure with defects much greater, and whose weakening effect would be tremendously more serious, are accepted without question.

We see welding electrode specifications being written which enormously increase the cost of production with no increase in either the reliability or in the excellence of electrodes. Rivets have no such test to handicap them.

While welding electrode is tested in every conceivable and nonsensical way, no one suggests any test on a rivet, yet the riveted joint is always the weakest spot in any structure. This is never true of a fullsized welded joint.

(Continued on page 1219)

THE NEW ARITHMETIC IN STEEL

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EQUAL 40 FINISHED UNITS

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CONTENTS NOTED

Continued from page 1217

Much time and expense is used in [te]sting electrode deposit to make sure [it] has great ductility and the weld [is] rejected if the ductility is low, yet [ri]veted joints have no elongation and [ar]e accepted without question.

The contour of the deposit of a [w]eld is a matter of very close inspec[ti]on, yet no one examines the contour [o]f any rivet or the hole it only par[ti]ally fills.

All insured vessels must have their [w]elds X-rayed and any weld is re[je]cted if any infinitesimal defect is [fo]und, yet no one X-rays a riveted [jo]int nor rejects it because of the [v]oids between the rivets and the [ri]vet holes which are known to be [al]ways present.

Because of the higher elastic limit [o]f the weld metal, there is no load [th]at can be put on a welded struc[tu]re in which the weld is of equal [o]r greater section than the parent [m]etal which can affect the weld in [a]ny possible way until great distor[ti]on of the rest of the structure has [t]aken place. Such distortion would [m]ake that structure valueless for its [i]ntended purpose, yet all this testing [a]nd rejecting listed above is made [m]andatory in many welded structures —never in riveted structures.

Further instances of the same kind [c]an be cited by the scores. The exam[p]les shown are sufficient for the writ[e]r's purpose.

Welding over the years has done [a] more reliable job than the rivets it [h]as replaced. That record is conclu[s]ive. The engineering profession, [w]hich relies so completely on weld[in]g in so many cases, must recognize [a]nd resist this studied attempt to eliminate the arc welding process. The attack has already eliminated the economic use of welding in many structures. The success of such an attack on this tremendously valuable method is neither good advertising for the engineering profession nor good ethics for those involved in the attack. It is time we dealt with reality.

J. F. Lincoln,
President

The Lincoln Electric Co.,
Cleveland, Ohio

What Mr. Lincoln says about arc welding is likewise true of several other methods. For instance, in the field of fabrication of steel building framework, the use of cold-driven rivets is not generally accepted by sets of codes and specifications, although exhaustive tests have shown that this method of riveting is equal to and often better in quality than the conventional hot-driving of rivets. Perhaps the difficulty lies in the fact that engineering progress goes forward at a much faster pace than is followed by groups, both private and public, that set formal specifications and procedures.—The Editors.

Authorship of Articles

To the Editor:

Enclosed is my filled-out questionnaire concerning the editorial policy you should pursue most suitably to fill my requirements as a reader. You ask for comments, so here is one!

I think you should have more articles by leaders in the fields of metallurgy and engineering and less by your associate editors. Your reputation was built on such articles as reference to back files will show.

A. E. L.

Detroit, Mich.

Perhaps there is some justification in your comment on authorship of articles, but we have definite reasons for having a large percentage of our technical articles written by our own staff. First, by writing certain types of articles ourselves we can cover the subject in exactly the way we know our own particular group of readers want them treated. Second, articles so prepared are seldom confined to information supplied by just one individual or one company. Thus, a broader picture is furnished by citing experiences or expounding engineering philosophies of a cross-section of leaders in any particular field, since most of our staff-written articles are based on fact finding interviews with and surveys of several leaders in a field.

Indeed, our manner of presentation has brought us much more praise than censure, for we have earned the reputation of being intelligently critical of a given material or processing method and presenting its disadvantages as well as its advantages. For instance, the same questionnaire, brought, among others, these two comments having a bearing on our method of presentation: (1) "Your biggest asset is that when you review a process or material you evaluate competitive processes or materials. This is important. Other magazines simply copy advertising matter which may be misleading"; and (2) "Just keep up the good work —your alert editorial staff has my profound admiration and appreciation. Of about 20 subscriptions, yours is outstanding in the technical field—I compare it (favorably) with Time *and* Fortune *in having a good policy and handling it well."—The Editors.*

F·125 THE ROAD TO PRODUCTION

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It seems like simple common sense, then, to face the fa that YOU have a tremendous personal stake in seeing that mo and better goods are produced through YOUR efforts than ev before. The Road to Production leads to individual securi through PERMANENTLY improved living standards. It can ta us far, or to a dead end, depending upon how each of us adap himself to that first essential . . . MORE OUTPUT.

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The Warren City Mfg. Co., Warren—WARCO PRESSES and PRESS BRAKES

MATERIALS & METHODS Engineering File Facts

NUMBER 124
November, 1946

MATERIALS: Cast Nickel Alloys

Cast Nickel Alloys

—some important properties

Property	Alloys: Nickel	Monel	Inconel	"S" Monel: As Cast	"S" Monel: Heat Treated	"H" Monel	Resistance Alloy
Tensile Strength, Psi.	45,000-60,000	65,000-90,000	70,000-95,000	110,000-145,000	110,000-145,000	85,000-90,000	60,000
Yield Strength,[1] Psi.	20,000-30,000	32,500-40,000	30,000-45,000	80,000-115,000	80,000-115,000	50,000-55,000	47,000[3]
Elongation,[2] %	30-15	45-25	30-10	4-1	4-1	15	2.0
Hardness, BHN	80-125	125-150	160-190	275-350	235-375	190	190
Izod Impact, ft.-lb.	90-75	80-65	85-70	9-3	5-1	45-40[4]	——
Mod. of Elasticity in Tension, Psi.	30,000,000	26,000,000	31,000,000	21,000,000	——	26,000,000	——
Mod. of Elasticity in Torsion, Psi.	11,000,000	9,500,000	11,000,000	——	——	——	——
Poison's Ratio	0.31	0.32	0.29	——	——	——	——
Density, lb./in.^{3}	0.321	0.319	0.307	0.303	——	0.313	0.303
Mean Coef. of Thermal Expansion: 70 to 212 F	0.0000072	0.0000078	0.0000064	0.0000068	——	——	0.0000245
70 to 570 F	——	0.0000083	0.00000896	0.0000082	——	——	0.0000252
70 to 1100 F	——	0.0000089	——	0.0000087	——	——	0.0000270
Mean Specific Heat, Btu./lb./deg. F	0.13	0.127	0.109	0.13	——	——	——
Thermal Conductivity Btu./ft.^{2}/hr./deg. F/in.	420	180	104	180	——	——	——
Magnetic Transformation, Range F	680	110-140	−40	−70	——	——	——
Melting Range, F	2615-2635	2370-2460	2540-2600	2300-2350	——	2300-2400	——
Electrical Resistivity, ohms per 1000 ft.	576	290	590	380 (at 68F)	——	——	——
Temperature Coef. of Resistivity, per deg. F	0.0024-0.0028	0.0011	——	——	——	——	——
Chemical Composition (Per Cent)	Nickel	Monel	Inconel	"S" Monel		"H" Monel	Resistance Alloy
Nickel	99.4	67.	78.5	63.		65.	57.
Copper	0.1	30.	0.2	30.		29.5	——
Iron	0.15	1.4	6.5	2.		1.5	Remainder
Manganese	0.2	1.	0.25	0.9		0.9	3.0 (max.)
Carbon	0.1	0.15	0.08	0.1		0.1	0.25 (max.)
Silicon	0.05	0.1	0.25	4.		3.0	1.0 (max.)
Sulphur	0.005	0.01	0.015	0.015		0.015	0.030 (max.)
Chromium	——	——	14.0	——		——	——

[1] *0.2% offset*
[2] *In 2 in.*
[3] *Proportional limit*
[4] *Impact value at −310 F is 47 ft.-lb.*

Compiled by Robert S. Burpo, Jr., from "Mechanical Properties of Metals and Alloys" (Circular C447) and information supplied by International Nickel Co., Inc.

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MATERIALS & METHODS Engineering File Facts

NUMBER 125
November, 1946

METHODS: Heat Treating

Relief of Stresses in Steel Products

Some data on the thermal relief of internal stresses in steel castings and wrought steel weldments are graphically summarized in Figs. 1 and 2. These curves represent the averages of a number of tests using cast and wrought (welded) steels varying in yield strengths from 26,000 to 65,000 psi.

There are four major variables in a thermal stress relieving cycle: heating rate, maximum temperature, time at heat, and cooling rate. The heating and cooling rates do not alter the amount of stress relief, but they must be controlled to permit uniform expansion and contraction. Within the range of 750 to 1300 F, the percentage relief of internal stresses seems to be independent of steel type, composition and yield strength. The effects of varying time and temperature are shown below.

Fig. 1. Effect of temperature and time on the relief of internal stresses

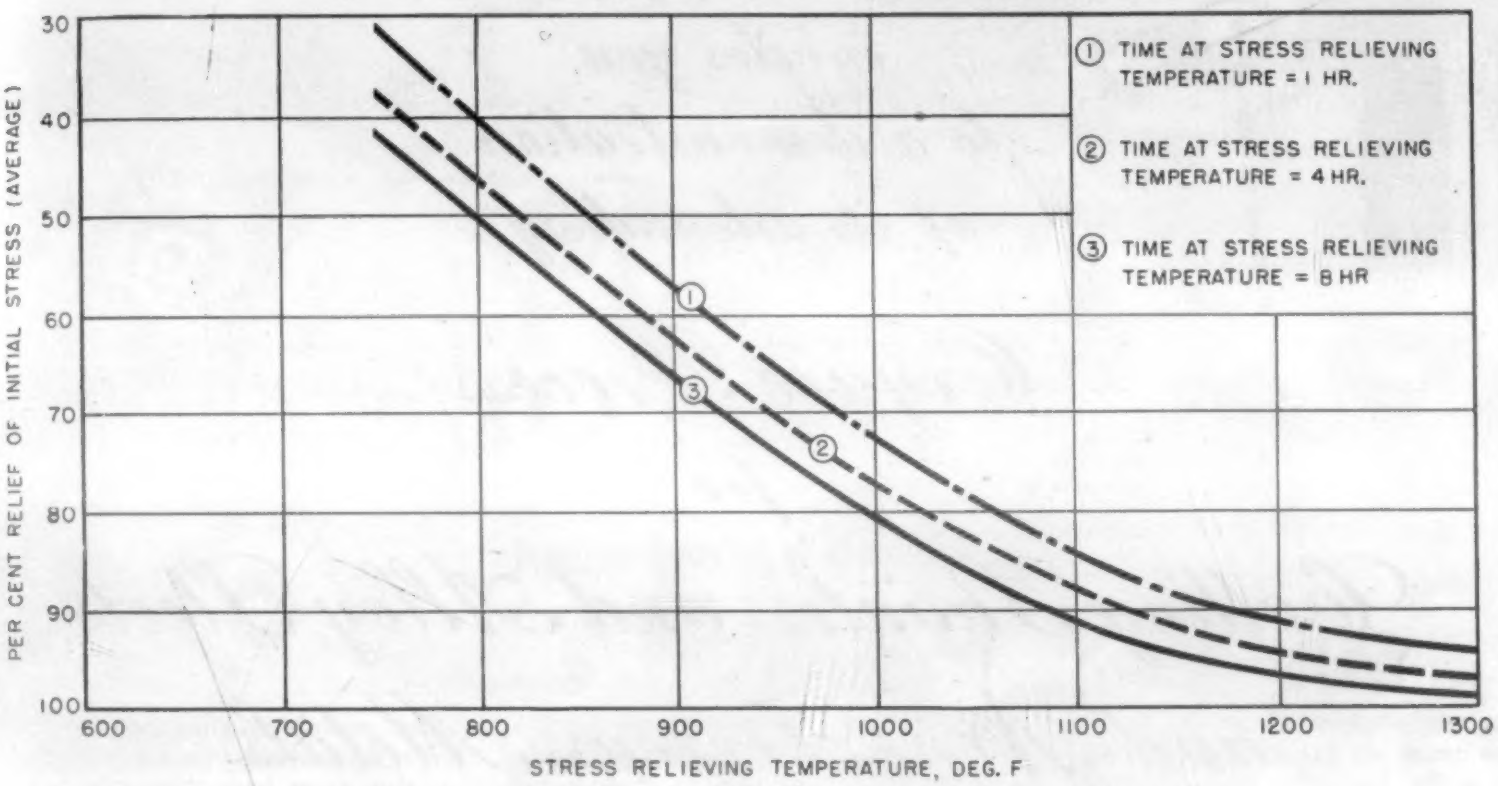
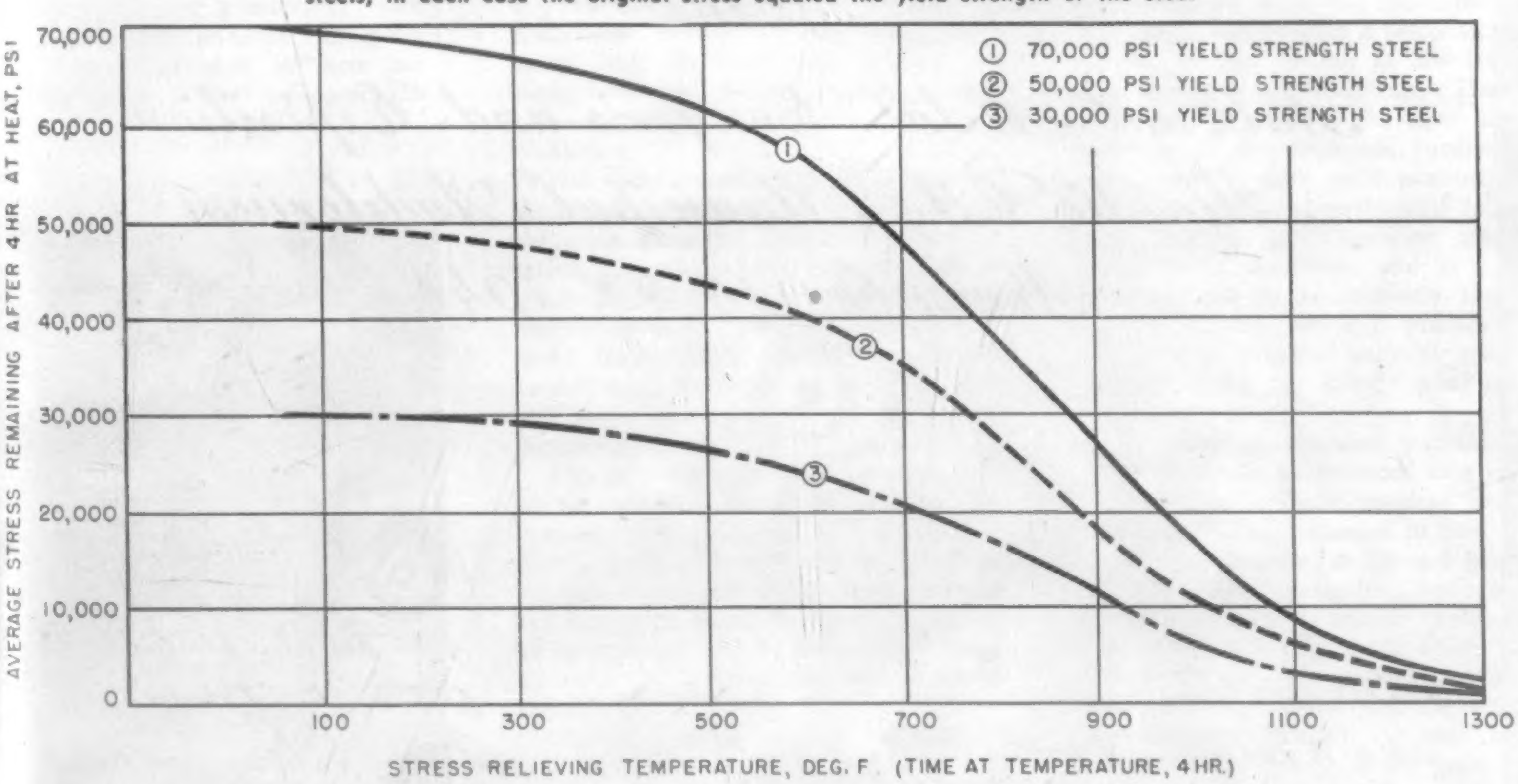


Fig. 2. Relief of stresses after 4-hr. thermal treatment of low and high strength steels; in each case the original stress equaled the yield strength of the steel



Adapted from a paper entitled "Thermal Relief of Residual Stresses in Steel Castings and Weldments," by C. R. Jelm and S. A. Herres, which was presented at the Fiftieth Annual Meeting of the American Foundrymen's Assn.

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engineering

SHOP NOTES

Precision Tumbling of Metal Parts

by R. M. Lord,
Norton Co.

In the past, deburring operations as well as surface finishing operations of a wide variety of miscellaneous parts such as gears, castings and threaded parts have been done on bench grinders or with small portable type grinders. In many instances, operations such as these are being eliminated today by precision tumbling.

A typical small tumbling unit with a three-compartment barrel. (Courtesy: Wright Aeronautical Corp.)

Tumbling produces uniformity in operations such as breaking sharp edges, producing radii to blueprint specifications, finishing or superfinishing operations, and also has brought about improvement of micro-inch finishes. It controls dimensional loss, increases wear-resistance of parts, eliminates rework and the human element, and reduces manpower and manhours.

The three essentials of tumbling are the barrels, abrasive and water. One of the most successful barrels from which satisfactory results have been obtained is the horizontal fixed type which is 8-sided and rotates at 21 rpm., which is the best speed for tumbling. Barrel sizes depend largely upon the requirements of the user and range in load capacity from 1 to 6 compartments.

The grit size or mixture of sizes used in the operation should be such that the abrasive will reach all of the recesses, fillets, angles and slots, without becoming wedged in any part of the work. Usually, the abrasive is mixed with a small amount of commercial cleaner and enough water to reach the level of the mass when in the barrel.

The amount of abrasive needed for the load of work to be processed will depend entirely on the type of barrels being used and the material being finished.

The volume of water to be used is important in controlling the action in the barrel and on the results of the processed products. Decreasing the water will give more grinding action and reduce the time cycle, but will produce a rougher finish. Increasing the water will retard the grinding action and produce a smoother finish. Operations can be run at low level for fast grinding or roughing. Then, by adding more water to the same mixture, finishes can be improved further in a predetermined time cycle established.

The conventional methods of deburring and finishing gears involve numerous bench hand operations, and as a result, may be said to be relatively slow and costly. Furthermore, it is practically impossible to produce uniform radii and surface finish by hand grinding and polishing.

By means of precision tumbling these same gears can be deburred in a fraction of the time formerly required and with a corresponding reduction in cost.

In one operation, burrs and heat treat scale are removed, perfect, uniform radii are produced to blueprint specifications, and a uniform high-grade finish is produced on the entire gear. In addition, it has been determined that the action of the tumbling abrasive imparts a hard, wear-resistant surface to the gears.

It should be pointed out that the abrasive tumbling of gears does not dam-

(Continued on page 1229)

Our new booklet—"Murex Arc Welding Electrodes"—contains 89 pages of useful information—surveys the development, manufacture and use of the complete Murex line. Booklet contains:

ELECTRODE GUIDE

Indicates briefly which Murex electrode to use for a particular welding application—gives recommended procedures for obtaining best results.

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ge the tooth form. This has been efinitely determined by careful inspection f the involute.

Finish-honed bushings and other parts an be abrasive tumbled to remove sharp dges, not only without damaging the oned surfaces, but in some instances, ven improving it in terms of micro-inch eadings. A micro-inch finish as low as .5 rms. can be maintained while higher eadings indicating a poorer finish can e even reduced 3 to 4 points. To cite n actual case, a 10 micro-inch reading on he O.D. of a small steel bushing was educed to 6 after tumbling for 3 hr. ith Alundum Tumbling Abrasive in the escribed manner while at the same time he 1 to 1.5 micro-inch reading on the oned I.D. was not altered.

By the conventional method of hand inishing, it was difficult to avoid marring he honed and finish ground surfaces, ith the result that the rejections ran very igh.

Layouts for Machine Gas Cutting Made with Wrapping Paper

by Elmer Kappel,
Allis-Chalmers Mfg. Co.

Substitution of ordinary wrapping paper for a plate of sheet iron in making layouts for machine acetylene cutting has saved work and sheet iron and increased job accuracy at an Allis-Chalmers Mfg. Co. layout department.

A layout was formerly made on either a sheet iron or directly on a track board. On sheet iron, the layout was difficult to follow, whether it was traced with soap stone, pencil, or scratch awl. On completion of the layout, the template was cut to shape—a long and tedious process, especially on inside cuts. Next, the plate was transferred to the track board, where a special marking had to be made around the plate before the track could be laid. Sharp, knife-like edges and slivers on the hand-sheared sheet iron template made this task hazardous.

When the layout was laid directly on the track board, much time was used in sanding and cleaning the board to make certain that marks from the preceding layout were removed, for unobliterated old marks often caused costly errors.

All these difficulties are overcome by simply stretching a piece of kraft paper over the board and making the layout on it. The track may then be laid directly on the paper, and the job is ready for cutting.

The service life of pots for melting and casting light metal alloys, such as aluminum and magnesium, has been increased from 4 to 5 days to several weeks by coating them with porcelain enamel.

—From "Porcelain Enamel Items"

A Handy Sawing Method

by Robert Mawson

John O. Pelchat Sawing Service, Providence, R. I., is engaged in sawing all types of metals and they come across many problems. With this varied experience they have developed many short cuts and methods to help them do their work, and this article describes one of these methods, making a die on a DoAll machine.

The first operation is drilling a small hole in the center of the high-speed steel block. The design of the die is then marked out on its face. The die block is then placed on the machine table, the saw placed through the hole in the die block and the two ends of the saw welded. (This work being done as one of the features of this machine.) The saw is then placed over the guide pulleys of the machine and tension added until the saw is ready for operation.

So far the operations described are standard when performing sawing operations. However, we will now describe the special method and attachments developed by this company.

At the rear of the machine table has been attached a bracket "B" in which is placed a roller chain sprocket "C", which can turn freely on a center pin. On the machine shaft "D" has been fastened a bracket arm "E" which carries two guide pulleys "F" which can also turn on center pins.

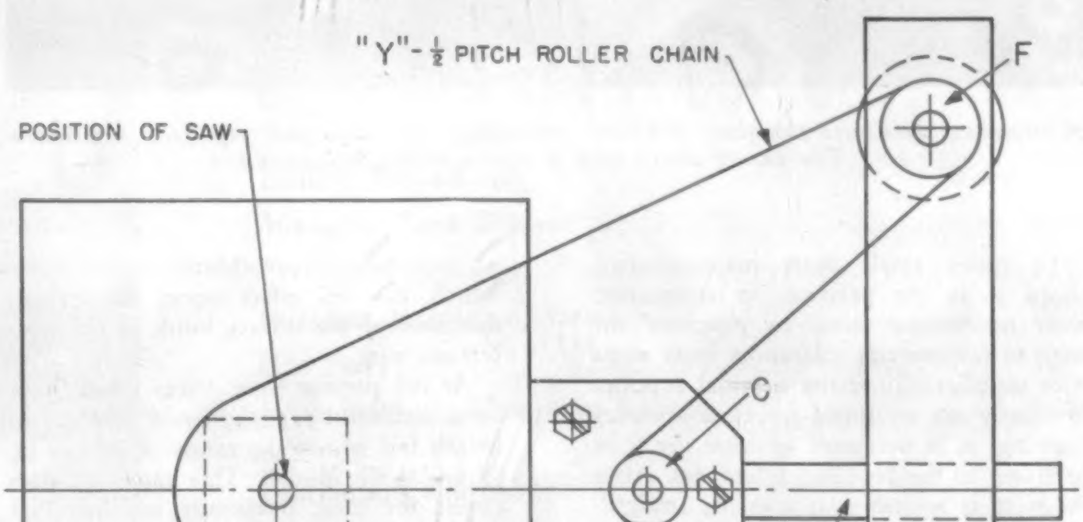
To use the equipment, after the die block and saw have been placed in position, as described, a ½-in. pitch roller chain "G" is placed around the guide pulleys, sprocket, and die block, as shown in the drawing.

The bracket arm is then fed back, this being one of the features of the machine, until sufficient tension has been placed on the die block to hold it securely. The machine is now started in operation and the desired shape of the die is cut, the man feeding along the machine table (and, therefore, the die block), guiding the die block by holding the chain at the rear of the block.

With this chain holding device the man can move the block easily and accurately to any desired position, the chain moving around the guide pulleys and sprocket with little or no effort and yet with sufficient rigidity to hold the block in position.

To review the methods often used for this work, the man attempts to hold the die block on the table without being clamped, but at best the work is ragged and dangerous to the man; another method is to clamp the block on the table. However, with the example here shown this would require eight different settings and fastenings.

The method with attachments here described not only does a better job in much less time, but also with no danger to the operator.

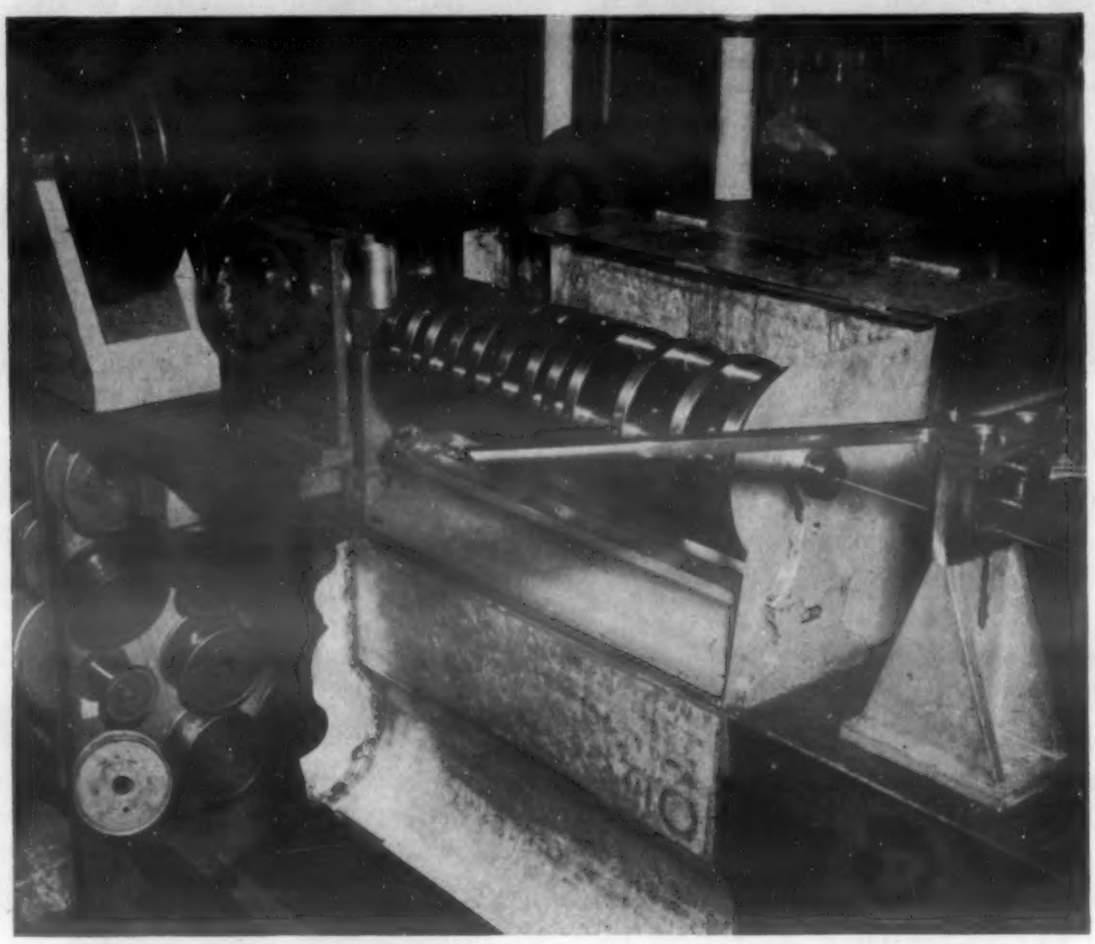


Assembled drawing showing the essential features of the saw attachment.

New Method of Wire Straightening

by G. E. Shubrooks,
Hamilton Watch Co.

It is necessary, in manufacturing extremely accurate parts for timekeeping instruments and other small instruments, to use a variety of sizes of round wire (both ferrous and nonferrous) with extremely close tolerances in dia. Small indentations, caused by some methods of straightening after the wire has been drawn to accurate size, are not permitted.



Nonferrous wire straightening machine containing the dies and the feed attachment. The cut-off attachment is shown in the foreground.

In many small parts manufacturing shops it is the practice, in connection with nonferrous wire, to purchase the wire to commercial tolerances from some wire supplier. Since the original supplier is usually not equipped for close accuracy drawing, it is necessary to have the wire re-drawn to the required tolerances. After the wire is re-drawn, it must be straightened without marking or damaging it in any way.

The Hamilton Watch Co. set about developing a machine to do this straightening job. Some tentative ideas were accumulated in the form of an original model straightening machine. Some fairly satisfactory results were obtained. However, some fundamental faults were also encountered in connection with the feeding mechanism and the dies. These faults were corrected and it was found, in the second model of the machine, that hardened steel dies with an extremely high polish gave improved results. This machine was also equipped with a suitable feeding attachment and a manually operated cut-off attachment so that the wires could be cut to uniform 3-ft. lengths.

It has been found that additional improvement, as far as straightening marks are concerned, can be obtained by cadmium plating the wire prior to the straightening operation. After this operation, the cadmium plating is easily stripped from the nonferrous wire by the use of a short-time hydrochloric acid pickle which has no effect upon the overall tolerance or the surface finish of the nonferrous wire.

At the present time, wires which have been successfully straightened and cut to length fall within the range of 0.0498 in. to 0.020 in. in dia. This range of sizes covers the most frequently required diameters of material. It is believed that additional wires, both larger and smaller in dia., could be successfully processed.

Our cupboard is almost bare. We need some good Shop Notes to stock it again. So don't hesitate to send in your kinks and ideas on how to do a job better. We pay for those published, too.

Soap may be useful in testing certain types of cast parts. For example, to test B-29 fuel injection system parts and to permit ready separation of porous parts from sound parts, a film of soapy water is brushed on the metal surface, the openings are plugged, and air is forced into the hollow portions. Telltale bubbling on the parts indicates a poor risk and the casting is rejected.

—From "Monsanto Magazine"

Cleaning Aluminum Before Welding with Inert-Arc Method

by M. J. Conway,
General Electric Co.,
Electric Welding Div.

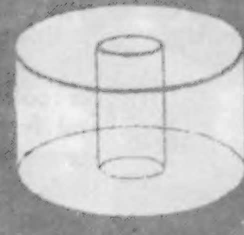
In searching for a satisfactory method of cleaning aluminum in preparation for welding with the inert-arc process, General Electric engineers recently found that dips in sodium hydroxide and sulfuric acid produce mirror-bright, fine-contoured welds as welded.

The first method tried was wire-brushing, but this only folded the oxide and dirt into the surface of the aluminum. Next, sandpaper was tried. This was successful if all kerosene or lard oil which had been used as a lubricant in machining the aluminum had been completely removed before the sandpaper was applied. It was satisfactory for bulky work, but too slow and crude for cleaning small parts rapidly.

The logical answer seemed to be a chemical dip followed by washing; and nitric acid, which has been used extensively for aluminum brightening, was used. However, when a sample was welded after being cleaned by this method, the weld bead was sprinkled with a black substance which accumulated in small surface pits. The discoloration was easily brushed off, but the pits remained to mar the surface of the bead.

When it was determined that the specks were not caused by too great a percentage of nitrogen in the argon welding gas or from faulty power supply, it was deduced that the cleaning method was responsible. Since the specks were rich in nitrides, the nitric acid was blamed, and sulfuric acid was tried in its place.

After a brief degreasing in a 5% solution of sodium hydroxide to remove all grease, oil, or wax, and a brief wash in water to remove most of the caustic and scum, the aluminum was dipped in a 50% sulfuric acid bath. This completed removal of the oxide skin and restored most of the surface brightness; a hot water bath removed the acid and left the aluminum clean and dry. Welding tests made on samples cleaned by this method resulted in mirror-bright, fine-contoured beads as welded.



Edited by H. R. Clauser
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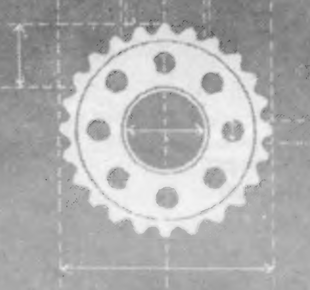

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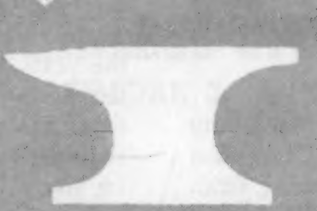


MATERIALS & METHODS DIGEST

A selection of outstanding articles on engineering materials and processing methods in the metal-working industries.

MATERIALS and DESIGN

Metals and Alloys

Nonmetallic Materials

General Product Design

METHODS and PROCESSES

Melting and Casting

Fabrication and Treatment

Testing and Inspection

METALS and ALLOYS

Engineering properties and applications of carbon, alloy and stainless steels, irons and nonferrous metals and alloys. Selection and evaluation of metallic materials for engineering service. New alloys and modifications.

British Cast Iron Uses

Condensed from "Iron and Steel"

Whether given material is a cast iron or steel cannot be precisely determined from its carbon content alone because of other elements found in both iron and steel. Usually a microscope will identify the material. In a pure iron-carbon alloy the limit is 1.7%. With lower carbon content, we get steels and with higher, up to about 4%, we get cast irons.

An alloy of over 1.7% carbon and iron is hard, brittle and unmachinable, since carbon exists in the combined state as cementite. The cementite confers on the fracture a characteristic appearance; hence, it is called white iron. It is resistant to abrasion, erosion and wear. White irons form the starting point for the manufacture of malleable cast irons, produced by submitting white iron castings to a thermal treatment or anneal, resulting in a comparatively ductile material.

Gray cast iron is machinable, because only part of the carbon is alloyed as cementite, the rest being present as free graphite. Silicon is the element which guides the division of these states. The bulk of cast iron is used in the as-cast condition, though it may be thermally treated to soften it for machining, or to relieve stress and improve mechanical properties.

Castings can be made in sizes from fractional ounces up to 200 tons in one piece. They may have tensile strengths of 9 to 26 tons per sq. in.; malleable castings can be produced with elongation in tension from 3 to 20%; when surface treated for hardness, they may reach 1,000 Brinell.

Finishing processes take one of three forms. The surface of the metal can be chemically modified, as in oxide or phosphate treatments; a coating can be applied, as in the vitreous enamel process; metal coatings, such as tin, zinc, and silicon, can be applied by hot dipping; and chromium, zinc and aluminum can be applied by other processes. Many metal coatings can be applied by electroplating or metal spraying. Paint, varnish or lacquer also can be applied.

Ordinary machinable gray cast iron is structurally pearlitic or ferritic, or a mixture of both, while white irons are predominantly cementitic. Austenitic cast irons are especially resistant to heat and corrosion and are nonmagnetic and relatively ductile, while martensitic cast irons are highly resistant to wear and abrasion.

The latest type, acicular cast irons, can be produced commercially in strengths of 25 to 45 tons per sq. in. and tougher than other engineering irons. Cast iron was extremely versatile during the war. It was used for practice shot, shell, H.E. bombs, smoke bombs, incendiary bombs, fuse bodies, grenades, mine sinkers, locomotive wheel centers, tank track links, bogie wheels, brake drums for tanks, and armored fighting vehicles.

One British foundry alone during the war produced over 75,000,000 castings. A striking development is the cast iron crankshaft. It absorbs vibration, shows unusual wear, and can be cast very closely to finished size. (J. G. Pearce. *Iron & Steel,* Vol. 19, Aug. 1946, pp. 475-479.)

Low and Medium Alloy Cast Steels

Condensed from "The Iron Age"

The development of an air hardening quality in steels is a result of increased thermal sluggishness in transforming from the austenitic to the ferritic state caused by the addition of certain alloying elements.

Classification of some of the cast low alloy steels with regard to thermal characteristics on cooling from above their critical temperatures can be made as follows: (a) Steels with no suppressed transformations on air or slow cooling, resulting in low hardness and a high degree of ductility, such as those containing up to 1% manganese, 1% nickel, or 0.5% chromium; (b) steels with suppressed transformations on air, but not with slower cooling rates—those containing 0.5% molybdenum and low manganese; (c) steels with suppressed transformations on the slower than air cooling resulting in hardness values up to about 300 VPN. The molybdenum-high manganese, chromium-molybdenum, nickel-molybdenum, and nickel-chromium-molybdenum steels can be included in this group.

The cast medium alloy steels, such as the 5% chromium, 0.5% molybdenum, 0.30% carbon steels, have suppressed transformations even with a slow cooling rate of 5.8 F per min., resulting in hardness values up to about 500 VPN.

Steels transforming at high temperatures on cooling have normal "clean cut" pearlite and ferrite structures. A harder Widmanstatten type of pearlite is formed in the steels having partially suppressed transformations. As the transformation temperature is decreased, the amount of this structure is increased. With further suppression of the transformation, hard bainite and martensite structures are produced.

Strength and hardness of heat-treated cast steels are raised in proportion to the increase in thermal sluggishness. This is also accompanied by a gradual decrease in ductility and impact resistance.

Knowledge of the thermal characteristics and existence of suppressed transformations is important in determining the most desirable heat treating and welding procedures for a given steel.

The rate of transformation at constant (isothermal) temperatures after austenitizing was determined for a cast 5% chromium, 0.5% molybdenum steel and the results plotted as an S-curve. Impact resistance, yield point and proportional limit of a sample isothermally transformed at 1340 F were sharply reduced over that obtained by regular heat treatment. Other properties were only affected to a small extent. (W. L. Meinhart. *Iron Age,* Vol. 157, June 27, 1946, pp. 44-54.)

Steel at High Temperatures

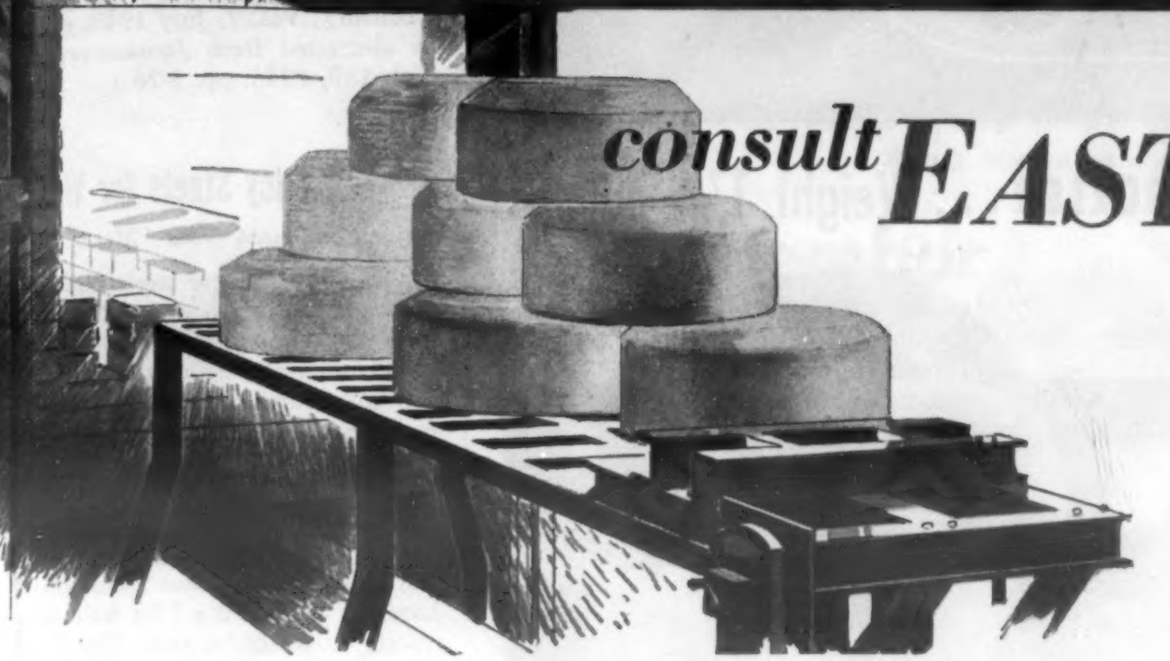
Condensed from "The Engineers' Digest"

To obtain general information with regard to the tendency to embrittlement of steels, a series of investigations was made at the Institute for the Investigation of the Strength of Materials of the Royal Swedish Technical University, Stockholm, during the years 1942-1944. Specimens were subjected to a 1000-hr. test at 932 F. Tabular data are presented giving approximate analysis, heat treatment and strength of the 16 steels investigated.

When subjecting unstressed specimens of certain steels to heating at 932 F for various lengths of time, it was shown that Steel No. 10 suffered increasing embrittlement with the test duration. This material is alloyed with approximately 0.65% molybdenum and should not, therefore, exhibit temper embrittlement in the ordinary sense. It would, however, appear that this molybdenum percentage is not sufficient to prevent embrittlement in the case of extremely long heating time. This observation is in agreement with present day concepts regarding temper embrittlement.

For pointers

on Heat-Treating Stainless



consult EASTERN!

Softening 18-8? How long should 10-gage E-S 18-8 (Type 302) sheet be held at heat to soften it between deep-draws? Can it be heated in a salt bath?

Oil-Quenching? Will oil-quenching make E-S 18-12 Mo stainless (Type 316 plate pick up carbon and lose corrosion-resistance?

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Burn Off Oils? Will the soluble oils used in drilling E-S 18-8 (Type 304) plate burn off without affecting it when the plate is heated to anneal the hard spots?

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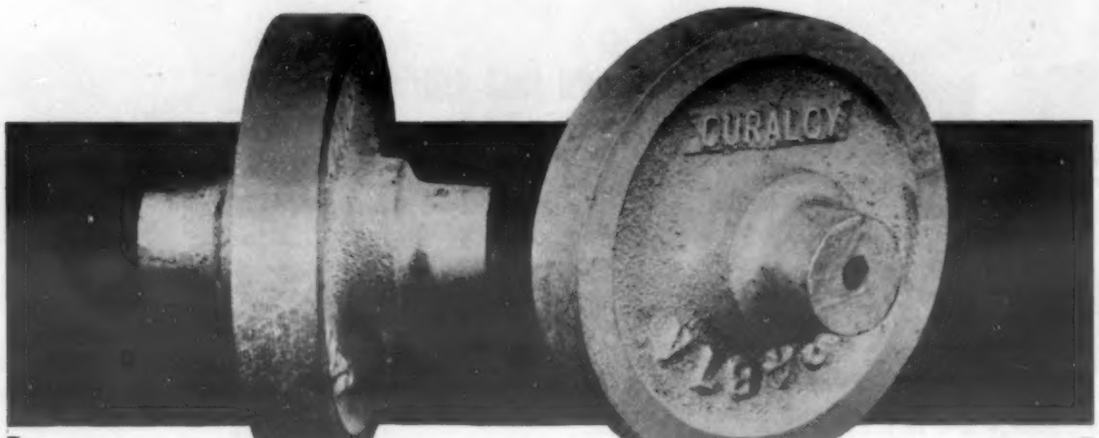

25% Chromium and 12% Nickel . . . these are the principal elements selected to provide these small rollers with the heat-resisting strength to carry the heavy loads in an annealing furnace.

But there's more to producing consistently sound castings than knowing which and how much of the several alloying elements to use. High alloy foundry experience is even more important. Shop facilities as well as quality and conditioning of the molding sand used count heavily toward satisfactory castings. These and other important contributing factors can be found in the background of the casting service offered by Duraloy Metallurgists and Foundrymen.

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This test was followed by a time-for-rupture test at 932 F, the test bars being provided with a circular notch. In order not to extend the length of the test unduly, testing time was limited to periods not exceeding 2000 hr.

The ordinary limiting creep stress test should be complemented by a corresponding test on notched test bars. In the latter test a stable material should not exhibit any tendency to embrittlement or to fissure formation in the notch similar to stress-corrosion. (C. Schaub. *Engineers' Digest* (British), Vol. 7, July 1946, pp. 205-206; as abstracted from *Jernkontorets Annaler*, Vol. 130, 1946, pp. 1-26.)

Low Alloy Steels for Welding

Condensed from "Metallurgia"

Carbon-manganese steels with, for example, 0.25% carbon and 1.5% manganese, meet the requirements of BS 548 (83,000 to 96,000 psi. tensile strength and 51,500 psi. minimum yield point) and are perfectly satisfactory in riveted construction. However, a new demand has arisen for high tensile strength steels with weldability good enough to permit use of ferritic electrodes.

The criterion of weldability has been taken as a maximum diamond pyramid hardness of 350 in a fillet weld of approximately 0.046 sq. in. area. The Reeve weldability test has been used throughout.

Carbon must first be carefully controlled, and thereafter the mechanical properties must be developed by suitable alloy additions. Considerations of weldability limit the carbon content to 0.20% maximum. Manganese is the cheapest alloy element, but contents over 1.5% cause a serious loss of ductility.

Tests on silicon steels do not justify the claims of decreased weld hardness and improved mechanical properties. The cost of nickel steels and the precautions necessary to ensure satisfactory welds limit their application to special purposes.

High phosphorus in steels of the Corten type does not affect weldability. These steels also have atmospheric corrosion resistance much superior to that of mild steel. Titanium and vanadium will combine with carbon and thus reduce its hardening effect.

Owing to the high cost and difficulties associated with their manufacture, titanium steels have not yet been produced on a commercial scale. Vanadium in combination with manganese has been successfully employed. Molybdenum increases the yield point of 2% nickel steel while Reeve tests show the maximum hardness compares favorably with that of carbon-manganese steel. Although molybdenum in combination with manganese has received considerable attention, the manganese contents (1.8% maximum) exclude such steels from the class of easily weldable steels.

Most of the present steels either have a maximum carbon content over 0.20% and therefore cannot be considered easily weldable, or the guaranteed yield point is not sufficiently high for many modern requirements which call for 56,000 psi. minimum. However, these requirements are met by a new steel (UXI), a typical composition of

This makes it *OFFICIAL

. . . a 91+% increase in 10 months of Peace-time consumption

Tons of Slab Zinc used in Die Castings

*(U. S. BUREAU OF MINES)

1945	September	8,969
	October	11,462
	November	11,285
	December	10,739
1946	January	13,764
	February	12,776
	March	14,753
	April	16,626
	May	16,319
	June (last published figures)	17,198

These figures from the U. S. Bureau of Mines speak for themselves. They furnish conclusive evidence that—as expected—die casting with its many new war-developed techniques would assume a role of ever-increasing importance in peace-time production, and that zinc would remain the preferred alloy base.

Die casting has proved itself as the answer to industry's need for accurate, high-speed, low-cost production of repetitive parts—just as zinc has proved itself as the ideal basic material for die castings. The figures shown above tell the story, but the story will be even better as more special high-grade zinc becomes available.

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which is 0.16% carbon, 1.09% mangane 0.45% nickel, 0.07% chromium, 0.26 molybdenum. The weldability is exceller

Reheating temperatures up to 1110 cause no loss in yield strength but improv ductility and toughness. The minimu yield point can be obtained in the h rolled condition on all thicknesses up to in. (A. J. K. Honeyman & J. Erskin *Metallurgia*, Vol. 34, July 1946, pp. 13 139.)

Oxidized Inclusions in Steel

Condensed from "Comptes Rendus"

In determining the properties of a stee the micro-inclusions are believed to play predominant role. About a hundred speci mens of a steel with 0.2 carbon, 4.5 nicke 1.3 chromium and 0.5 molybdenum we made in a high-frequency furnace with acid (silica) lining, killed completely, an containing 0.2 to 0.4% silicon and 0.2 0.4% manganese. Ingots of 225 kg. we cast and then forged into rounds of 95 mm These rounds were used to determine th resiliency in lengthwise and transverse d rection after they had been annealed to tensile strength of 100 to 130 kg. per s mm.

For each bar a double index of quali was determined by combining the longitu dinal resiliency L and transverse resilienc T, namely I = L + 2T and the rati L/T. A casting was considered to have better quality the greater the factor I an the smaller the ration L/T; I could var from 17 to 35 and L/T from 1.40 to 4.45 Differences in quality in the same stee could in this way be ascribed to differenc in sulphur alone in certain cases.

All steels contained micro-inclusions o not more than two or three hundredths of millimeter, and often of a few thousandth of a millimeter. The micro-inclusions we formed of silicon, aluminium, silicates o complex silico-aluminates.

Each steel contained only inclusions o the same nature or at least one preponder ant type of inclusions. According to thi predominant type of inclusion, the stee were classified in three groups: (1) In clusions of globular silicon dispersed in th whole mass of the metal without an marked orientation and localization; (2 inclusions of aluminum dispersed in th mass or, very often, arranged in groups o lines; (3) elongated inclusions of variou kinds (silicates or silico-aluminates of iro manganese, lime).

The quality indices were found to b for L/T: group I, 1.40-1.90; group II, 1.85 2.75, and group III, 2.05-4.45. The varia tion was brought about not by an increas in L, but by a reduction of T. It is there fore concluded that the nature of the micro inclusions determines quality of the meta as defined by the resiliency test, and mechanical action of the inclusions appa ently exists which, exerting itself in th direction of drawing, diminishes the co hesion between the fibres of the metal. Th mechanical action would be independent o the nature of the inclusions. (L. Colombie *Comptes Rendus*, Vol. 222, May 20, 1946 pp. 1231-1233.)

Zinc Base Die Castings

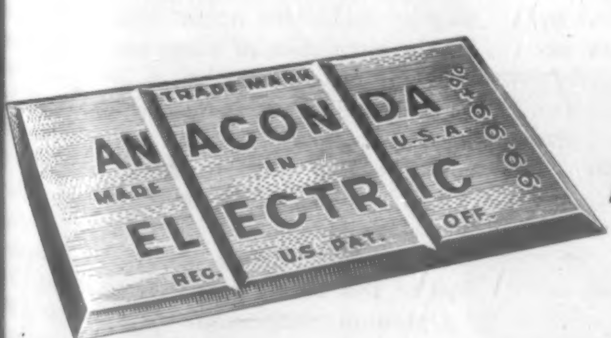
eliminate breakage of Desk Telephones

A FINE EXAMPLE of thin-section, deep-cored zinc base die casting is this desk telephone housing.

A zinc base alloy was selected by the manufacturer, Stromberg-Carlson, . . . "because of its mechanical strength, and its ability to take the smooth surface and sharply defined lines of the mold. Breakage under normal use is eliminated."

The strength, uniformity and casting characteristics of zinc base die casting alloys are largely dependent on the *purity* of the zinc. Anaconda Electric Zinc, 99.99+% pure, provides an always dependable base metal. 46392

The Stromberg-Carlson Desk Telephone and two views of the zinc base die casting which forms its housing.



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Adhesives

Condensed from "S.A.E. Journal"

Among the advantages claimed for bonded structures, the greatest is probably the benefit gained from the continuity of the bond. The resulting distribution of load, or elimination of concentration of stress, offers a solution to crippling or ultimate buckling stresses. In a stiffened sheet panel, this permits higher compressive loads and prevents initial torsional instability failures of the stiffener. Decreased basic structural weight also results.

The second most important property is the low modulus of elasticity of the cement. Absorption of impact, fatigue, and shear stresses in the bond allows broader design possibilities than are encountered with conventional methods of attachment.

The disadvantages are mainly in tooling, inspection of bond, and field repair of damaged structures.

Virtually all structural materials used in present-day fabrication can be bonded to themselves and in combination by use of adhesives of one type or another.

The properties of the adhesive to be used which must be considered include tensile shear, compression shear, tensile, shear impact, tension impact, tension impact fatigue, fatigue in vibration, cleavage, peel, flexural strength, effect of temperature, resistance to various agents and conditions, and creep under sustained loads. No one particular metal-to-metal adhesive excels all others in strength and permanence properties. In choosing an adhesive for a specific application, one must compromise on some features.

Material to be bonded must be clean. After application of the adhesive, a drying time of 5 min. or 1 hr. or longer is required. After drying, the parts are assembled, placed in a suitable pressure fixture, and heat and pressure applied to cure the adhesive.

Assemblies should be designed so that the bond is in shear or direct tension, eliminating peel and cleavage. The most economical way to increase the strength of a shear lap joint is to widen the lap.

In metal-to-metal joints, relatively light gages should be used. It is desirable that shear and tensile strength of the bond be as great as the strength of the material bonded. With metal-to-metal adhesives this can be realized with practical overlaps only in the thinner gages, because the tensile-shear strength of the cements is 3000 to 4000 psi.

The pressure devices employed should locate the parts properly with reference to each other. Provisions should be included for follow-up pressure. Some resilient material should be interposed between the part being bonded and the platen.

Application of pressure and heat can be accomplished simultaneously by use of the hydraulic press with flat heated platens, individual or multiple bench fixtures with toggle or quick-acting clamps, and built-in cartridge or strip heaters. For continuous production, simple clamping methods and tunnel ovens are desirable.

Warpage can be avoided by heating all portions of the curing die or fixture to a uniform and constant temperature, and by allowing the parts to reach maximum expansion before pressure is applied.

There is no positive method of inspection of a cemented joint. The end product can be controlled by controlling the process throughout the fabrication cycle. A certain percentage of production items is destroyed to show quality of bond obtained.

In general, the adhesive method of assembly is definitely competitive with other methods of attachment. (D. L. Swayze. *S.A.E. Journal,* Vol. 54, Aug. 1946, pp. 412-417.)

Injection Molding of Nylon

Condensed from "Modern Plastics"

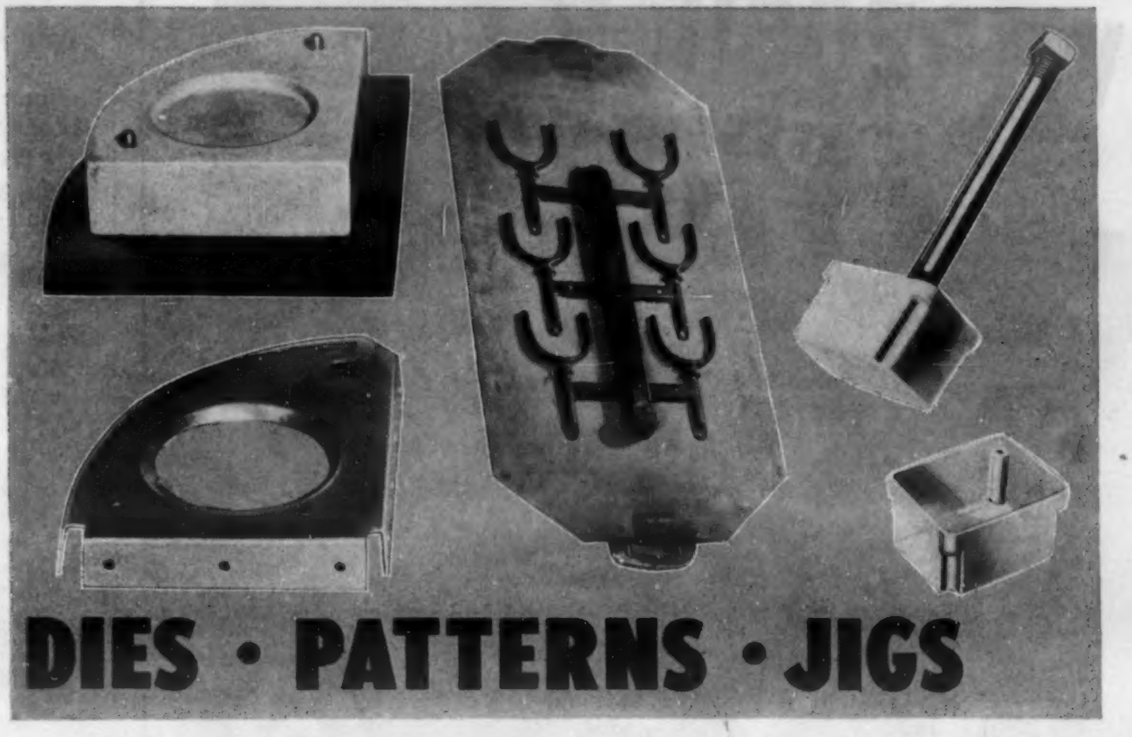
Nylon in the solid form is a truly cry- talline material, as demonstrated by X-ra studies. As a true crystalline material, has a relatively sharp melting point, an above that melting point, has about th fluidity of a light lubricating oil. Th sharpness of the melting point means th there is no intermediate viscous stage whic will permit the homogenizing of the mold ing composition by the mixing action o an injection piston and cylinder. Furthe the material will not issue from the nozzl until material temperature is above 505 F These characteristics made it necessary fo nylon to be treated somewhat different from other thermoplastic molding material

FM-1 nylon is a thermoplastic moldin material in the sense that it can be softene by heating, made rigid by cooling, an resoftened by reheating. Nylon is no thermoplastic in the sense of becomin progressively more fluid as the temperatur is raised. Once the material becomes ho enough to flow, it is so fluid that it wi readily escape from the clearances customa in compression mold design. Nylon i thermally quite stable, but being an o ganic material, it is susceptible to oxidatio at the high temperatures (about 520 F to which it must be heated in order to mak it flow.

This means that if FM-1 nylon is charge into a compression mold or a transfer po the nylon at the outside of the cavity mu be overheated in order to supply enoug heat to the innermost granules to permi the whole mass to flow. For these reason it is recommended that FM-1 and FM- nylons be handled only by the injectio molding method.

Following are recommendations base upon work with a large variety of molde shapes: Molds for nylon should be drille for the circulation of water and be operate normally at temperatures of 170 to 270 F Nozzles for most articles, which would b made in a 6-oz. or larger machine, shoul never be less than ¼ in. in dia.; nozzl temperature may best be the same as th of downstream end of the cylinder; contro of nozzle temperature should be indepen dent of that of the barrel temperature.

Optimum temperature of cylinder wi vary with the type of cylinder, the numbe of screens employed, and the amount o material per shot. Injection pressure, wit



CAST PLASTIC DIES · PATTERNS · JIGS

Typical of the current trend toward making production methods ultra-efficient is the use of Durez casting resin . . . to reduce the time and cost involved in conventional die-, pattern-, and jig-making . . to speed production

Cast Plastic Dies

Durez casting resin lends itself readily to cast forms for hydropress operation. The cast plastic die illustrated above left is used regularly under 75 tons press load and has produced hundreds of pieces, similar to the one shown below it, without flaw. Tests have shown it to be capable of withstanding up to 270 tons press load, equivalent to about 12,000 psi.

Cast Plastic Patterns

Alert foundrymen everywhere have been quick to see the production advantages of cast Durez resin patterns such as the match plate illustrated above center. The inexpensive Durez casting resin is simply poured and cured. The perfectly reproduced pattern is then mounted on the plate. The time- and cost-saving benefits are obvious.

Cast Plastic Jigs

The fixture, illustrated above right, for holding die-cast metal covers while a few finishing operations are performed is an excellent example of the simplicity of producing such fixtures with Durez casting resin. It was only necessary to coat the inside of one of the covers with a parting agent and pour in the resin. While the resin was in a semi-viscous state, the stud was located in place. After allowing the assembly to set for a few hours, it was placed in an oven and cured. When taken from the oven, the die-cast cover was removed and the fixture ready for use, the stud being anchored securely in the resin. Long-wearing qualities of the casting resin are excellent.

Characteristics of Casting Resin

Tests have shown that Durez casting resin may be sawed easily, that it drills like hard maple wood, that it will not hold heat or be softened by it, and that it will not ignite. Standard wood- or metal-working equipment may be used. The liquid resin follows the contours of any part exactly and holds them to predetermined tolerances. Its shrinkage factor is but .0025 inches per inch.

Other Uses

A few additional uses for Durez casting resin are stretch-press dies, masking shields for plating, models for testing and duplicating, and checking and assembly fixtures.

Informative Booklet

As specialists in the production of phenolic plastics and resins for almost three decades, Durez technicians have gained an enviable record for developing plastics and resins that fit the job. This background includes molding compounds, industrial and protective coating resins. The benefits which this rich experience can provide are available to you. Write for complete, authoritative folder on casting resin. Durez Plastics & Chemicals, Inc., 911 Walck Road, North Tonawanda, N. Y.

DUREZ

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INDUSTRIAL RESINS

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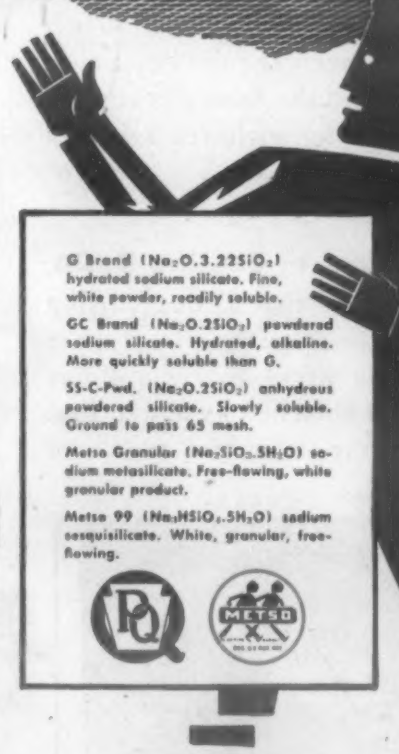

Sodium Sesquisilicate U.S. Pat. 1948730, 2145749
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METSO *Cleaners*

a clean nozzle and clean screens, and with nozzle, sprue and gates of adequate size, will range between 6000 and 18,000 psi.; charging of the cylinder should be done with gage pressure reduced below 400 lb. Sufficient time should be allowed to soften unmelted particles at the front of the cylinder.

Precautions to be taken in the molding of nylon are those involved in avoiding the risk of burning the operator. Nylon is so fluid that if the mold is not closed tightly, or the nozzle does not fit into the mold securely, there may be a dangerous spurt of molten nylon. (Russell B. Akin, *Mod. Plastics,* Vol. 23, Aug. 1946, pp. 139-143.)

Transparent Thermoplastic

Condensed from "Modern Industry"

New transparent plastics that will stand boiling water and most chemicals, that can be made in any color, cast like glass, and laminated at low pressures may be the answer to many a manufacturer's product problems. Flameproof wallboard that is water and chemical-resistant, durable lamp shades, signs, fishing rods, jewelry, wall tiles, luggage, and electrical and optical equipment are only a few of the products that can be made from these brand-new "see-through" plastics.

These plastics, unsaturated polyester resins, are not just one plastic, but a whole group. Chemical composition can be adjusted to make them flexible or rigid. Some won't burn, others are slow-burning. Some are outstanding in resistance to gasoline, others to acids or alkalis.

A combination of four properties in common distinguishes these polyesters from other plastic groups. They are optically comparable to glass and, like some other plastics, will "pipe" light. Surface hardness as high as 116 Rockwell M can be obtained, which means a high degree of mar resistance.

Polyesters are thermosetting plastics, and although they can be formed after curing, they will not melt, and can be placed in boiling water without damage. Unlike most thermosetting plastics, the polyesters give off no gasses during curing, therefore casting and laminating require only simple equipment and pressures of less than 15 psi. making continuous lamination possible.

Polyesters are still very new, and, in many ways, untried. While it is possible to make them water white in the laboratory, all commercial grades have a slight amber tint. Curing time for most castings is long and the shrinkage is usually about 9 to 14%. The pure resins can't be compression molded commercially at present.

Research now in progress may remove many of these limitations and when it does, you may expect to see polyester sewing machine housings, fans, toys, lightweight shipping containers, porch and lawn furniture, sales counters, and storage chests. (*Mod. Industry,* Vol. 11, June 15, 1946, pp. 49-52, 54, 56, 58.)

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GENERAL PRODUCT DESIGN

Selection, applications and design of parts made by various fabricating methods or made of special materials. Properties and uses of finishes and coatings. Design and materials for specific products or fields. General engineering design trends or principles.

Design for Metal Spinning

Condensed from "Product Engineering"

Metal spinning is a deep drawing process in which a circular piece of sheet metal is worked to the shape desired by forming it against a chuck revolving in a lathe. The chuck determines the shape of the part, and the dimensions of the part conforming to the surface of the chuck should receive special attention in the design of the part. The thickness and ductility of the metal are also of major importance.

Reflectors, lamp bases, lighting fixtures, air deflectors and many similar articles can be designed for production by spinning. Many covers for machines and equipment are produced by spinning for use in places where curved surfaces are wanted for appearance. Rigidity of the part can also be incorporated into covers designed for production by spinning.

Ductility is an essential property of any material that is used in making parts by spinning. 2S aluminum, which practically does not work harden, is one of the best materials. Soft copper also has low work hardening. Of the brasses, 70 copper-20 zinc has high ductility. It must be spun carefully with fast, accurate, heavy strokes to get the maximum draw between annealings.

Stainless steels are more difficult to spin than aluminum, brass and copper. Although stainless steels have high ductility, they cannot be spun without annealing to anywhere near the depth to which aluminum and copper is spun. Frequent annealing should be specified to avoid cold working the material during spinning to the extent that cracks are formed.

Low carbon steel can be spun to wider limits than the stainless steels. An annealing temperature of about 2,000 F is customary.

Bronze, magnesium, Monel, zinc, nickel, nickel silver and other alloys can be used for spun parts. Monel and nickel do not flow as much as the softer metals, so that the designer can make the spinner's job easier by specifying a blank slightly larger than that required for the softer metals. Annealing temperatures for Monel and nickel vary from 1,550 to 1,800 F. Nickel need be kept in the annealing furnace only about half as long as Monel, assuming equal temperatures.

Metal parts can be spun successfully in all sizes from ½ to over 100 in. in dia. Usual commercial tolerances are plus or minus 1/16 in. on large parts, 1/32 in. on parts of medium size, and 1/64 in. on small parts. Tolerances of plus or minus 0.005 in. can be maintained where necessary.

In general, sharp bends and fillets of small radius are to be avoided. Corners on wood chucks less than ¼-in. radius fall under pressure of the spinning tool. Sharp corners on plastic and Masonite chucks chip and break out. Where small radii are necessary, steel chucks are recommended. At best, the metal is always thinned more at corners by spinning so that radii should always be as large as the design of the part will allow.

Aluminum and soft copper can be spun economically in thicknesses as great as ¼ in. A thickness of 3/16 in. is about the limit for low carbon steel and ⅛ in. for the stainless steels. Aluminum sheet only a few thousandths thick has been spun on small work up to 4-in. blank dia., but blanks 0.010-in. thick are easier to spin. The majority of parts for production by spinning are made of blanks from 0.025 to 0.050 in. in thickness.

A primary reason why the spinning process is so important as a method in metal fabrication is its low cost on small-quantity production. If thousands of the same part are to be made, then the designer would choose a power press method of cold-working the part to dimensions. If only 50 or 100 were required, he would specify production by metal spinning. Where production by spinning stops and press production begins is debatable. Perhaps 5,000 parts is an average dividing point. (C. J. Holinger. *Prod. Engineering,* Vol. 17, Aug. 1946, pp. 150-153.)

Tin-Zinc Alloy Coatings

Condensed from "Tin"

A new tin-zinc alloy which will give a greater protective coating for steel has attracted considerable attention. This coating of 80% tin, remainder zinc, has been used to protect the sheet steel chassis of a radio receiving set. It solders easily, is attractive, and has a high degree of corrosion resistance. This coating is already in use among British manufacturers of radio equipment and electrical instruments.

The steel frame is used as a "ground" and thus, several soldered connections have to be made to it. Zinc is not feasible because soldering to it is difficult. Cadmium is costly and gives out toxic fumes when spot welding is used.

Tin, of course, has a high resistance to corrosion, is attractive, is spread easily and uniformly. However, if there is mechanical damage, such as at an edge or even at a pore, the process of rusting proceeds rapidly underneath the tin, which eventually disappears with the rust, though the tin itself is not attacked.

The corrosion resistance of zinc is not high, but when used as a coating on iron it protects the iron by a species of sacrificial action, and rusting does not occur so long as any zinc is left in the vicinity.

Accelerated testing of coating on metals are usually of two kinds. One consists of exposure to warm damp saturated air, which simulates extreme tropical conditions; the second is exposure to salt spray, which is akin to the worst maritime conditions. Specimens, when tested in Britain, consist of two different kinds of steel. One is a typical hot rolled steel used for Welsh tinplate, while the other is a typical cold rolled steel now used very widely for thin sheets.

Protective coatings used for comparison include pure tin, pure zinc, pure cadmium and several alloys of different proportions of tin and zinc. It has been established that there are tin-zinc coatings which give substantially higher corrosion resistance than either of these metals singly under certain conditions.

The results under "maritime" conditions are even more favorable than those under "tropical" conditions. Chemical film treatments have been developed that greatly enhance the resistance of these coatings.

It has been further established that these coatings are reasonably continuous and adherent and that, when the steel base is folded or distorted, the alloy coatings retain a satisfactory degree of protection compared with other competitive coatings.

The ratio of cost of tin and zinc may be taken as 10 to 1. Yet commercial coatings of zinc are commonly from 15 to 20 times as thick as the tin on tinplate. Tin coatings are found to be the very best if the coatings are of the same thickness as in general use of zinc, cadmium, etc.

It is common practice to paint many of these coated steels at some stage of their life. Zinc is a poor basis for paint, and

See what the other fellow... is doing with DIE CASTINGS

ODD SHAPES—CAST OR BENT

One of the principal advantages of the die casting process is the ability to cast unusual shapes. There are instances, however, where it is more economical to obtain a required contour by a bending operation *after* casting.

A design change in the *zinc alloy* die casting shown below required that the end of the pointer be curved, instead of straight as it was originally cast. This could easily be accomplished by altering the die but, thanks to the ductility of the zinc alloy, it proved to be less costly and quite satisfactory to bend the pointer after casting. There are many cases where a simple forming operation of this kind will prove to be more economical than to cast a shape which will involve high die cost or slow up the casting cycle.

KNOCKOUTS ARE OFTEN PROVIDED IN DIE CASTINGS

Knockouts—thin sections which are later punched out to provide openings—are frequently provided in die castings. The designer of such a part will do well, however, to attempt to so locate the knockouts that they will not constitute undercuts which will interfere with the ejection of the casting from the die.

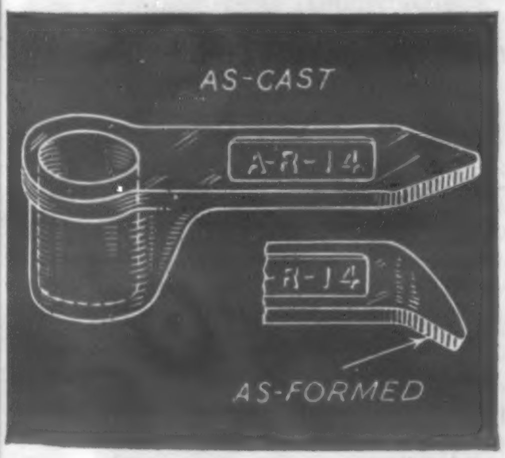
The *zinc alloy* die cast switch box below has eight knockouts to provide various openings for conduits and screws depending upon the particular type of installation. Six of these knockouts are in the bottom of the box and, since they are parallel to the die parting, they do not constitute undercuts. The knockouts at either end of the casting, however, require the use of slides having about 1/8" motion to clear the casting when it is ejected.

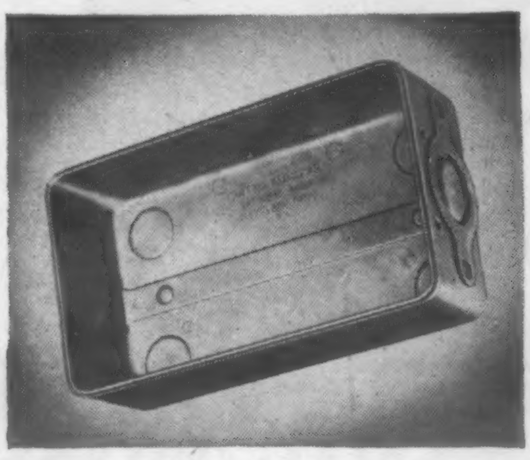
Naturally, the slides necessitated a more expensive die and there is some extra flash to be removed from the castings, but the knockouts are absolutely essential at these points and the extra costs were justified on this score.

Send for your copy

A Few Words About This Advertisement

This is the first advertisement in a new series which will appear in these pages during the months ahead. Because of our close association with the die casting industry, many interesting design and application ideas come to our attention. We propose, in these advertisements, to pass these ideas along to you to help in the solution of some of your problems. Watch for these ads and, in the meantime, ask us—or your die casting source—for a copy of the booklet "Designing For Die Casting"





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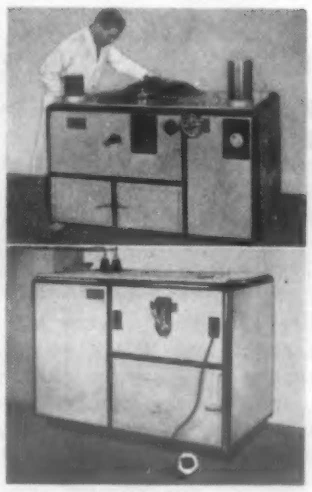

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Our best advice based on actual experience is at your service—ready to help affect a complete setup for the efficient production of precision castings to meet your individual requirements. Please call on us.

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galvanized sheets are not painted until they are heavily weathered. Tin, where coatings are very thin, is an excellent basis for paint. (*Tin*, July 1946, pp. 9-10.)

Small Quantity Die Casting

Condensed from "Die Casting"

Die casting is usually thought of as a process best adapted to the economical production of very large quantities of identical pieces. However, there are some cases in which die casting can be used to advantage in small quantity production of parts. The manufacture of metallizing guns is a good example of this. It is a highly specialized tool, and production quantities are small compared with consumer items. Each piece, therefore, must carry a proportionate larger part of the cost of dies. This higher cost can only be justified if it produces a better machine for the ultimate consumer, and if it pays off in reduced internal manufacturing costs.

The metallizing gun is made up of seven die castings. All are aluminum alloy for reasons of weight, strength, and finish. Let us briefly consider how these aluminum pressure die castings measure up to the requirements of a better product and reduced internal manufacturing costs. A better machine is obtained when these die castings are used because of: (1) fewer manufacturing variables, (2) greater improved appearance, and (3) much lighter weight.

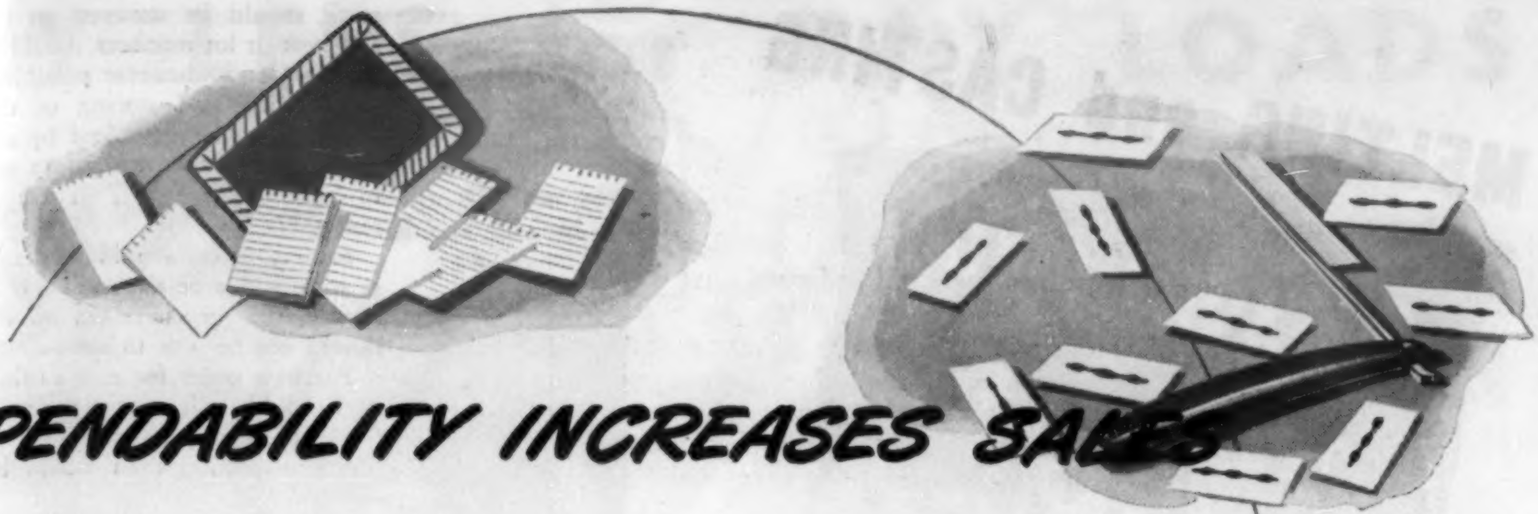
The reduction in internal manufacturing costs is a result of the following factors:

Machining—The amount of metal to be removed in machining is greatly reduced. Finish allowances can be cut by 75%. In the metallizing gun, because of the precision requirements, very few mating or operating surfaces are left as cast; however, finishing in many cases has been reduced to simple drilling, reaming or grinding.

Inspection—Because so little metal is removed in finish machining, superficial inspection of raw castings serves to catch imperfect pieces. In addition, all the shapes produced by a single piece of the die are solidly fixed in relation to each other, and shifts occur only across the partings. This makes the use of very simple single point inspection procedures possible.

Finishing—A metallizing gun has a polished finish all over for cleanliness as well as for appearance. Sand castings would require a large amount of rough and finish grinding, polishing and buffing. With die castings, only one "coloring" polish is required.

Fixtures—The cost of holding fixtures for machining is another important production cost in the manufacture of limited quantity precision equipment. Operating costs rather than first costs is important because the number of adjustments to be made affects the direct labor cost for each piece. Die castings, because of their consistent size and shape, simplify the drilling and milling fixtures because locations can frequently be made for cavities or cores which are fixed in relation to the required dimensions. (C. K. Wilson. *Die Casting*, Vol. 4, Aug. 1946, pp. 22-24, 39-41.)



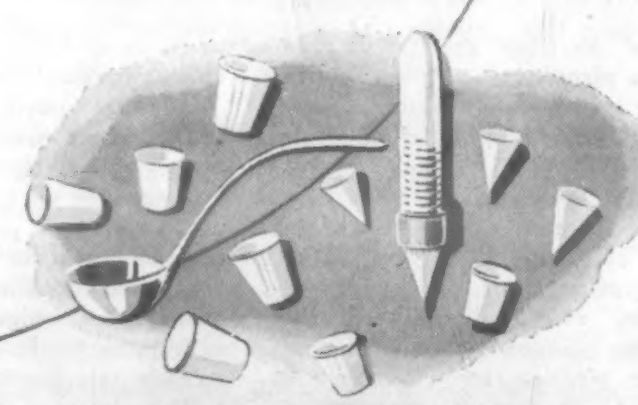
EXPENDABILITY INCREASES SALES

Would your product better meet consumer requirements if it could be "discarded after one using"? Would your sales jump?

The idea of PRODUCT EXPENDABILITY has made possible an advance in penicillin therapy by providing a method for administering a 24-hour dosage in one injection. A special cartridge-type LUMARITH plastic syringe —discarded after one using—is the basis of this new treatment.

The disposable-type syringe offers both medical and economic advantages . . . the one-daily injection replaces the usual eight, and at the same time maintains a steadier curve of therapeutic effectiveness . . . reduces the cost of treatment and minimizes patient discomfort.

The plastic syringe is a notable example of the possibilities of the expendable product. Can you use the *throw-away-after-one-using* principle in your product planning? The Celanese Technical Staff welcomes your inquiries—is prepared to show how the high-speed moldability and all-around production economies of Lumarith recommend this Celanese* plastic for the expendable product. Celanese Plastics Corporation, a division of Celanese Corporation of America, 180 Madison Avenue, New York 16, N. Y., producers of LUMARITH*, FORTICEL*, CELCON†, CELLULOID*, VIMLITE*.



SINGLE INJECTION SYRINGE

Molded—10 to a sprue—from Lumarith (cellulose acetate). The free-flowing characteristics of Lumarith insure a well-locked needle. The snug fit of the protective cap insures needle sterility. Molding cycle is 50 seconds—twenty seconds of which is consumed in placing the needles. Molded by Presque Isle Plastics Company of Erie, Pa., for Becton-Dickinson, Rutherford, N. J.

*Reg. U. S. Pat. Off.
†Trademark

MELTING and CASTING

Melting, alloying, refining and casting methods, furnaces and machines. Iron and steel making, nonferrous metal production, foundry practice and equipment. Die casting, permanent mold casting, precision casting, etc. Refractories, control equipment and accessories for melting furnaces.

Malleable Tank Wheels

Condensed from "Foundry Trade Journal"

This paper describes the layout and operation of a plant specifically laid out to produce large quantities of "Tank Wheel" castings in high-grade black heart malleable iron.

Molds for cope and drag are produced on three pairs of identical Pneulec Hermann jolt rollover machines, 20-in. by 36-in. tables, and gravity roller conveyors provided to carry away half-molds to the closing stations. To carry bottom halves to a suitable position for closing, and complete molds to casting conveyors, a transverse trolley with automatic stops is used for each pair of machines.

Seven casting conveyors, each accommodating 25 molds, are provided for each molding bay, the total capacity being 525 molds. In order to give a certain amount of gravitational assistance to molds traveling along the conveyors, these are sloped 7 deg., the floor being sloped the same amount so as to preserve uniform height for pouring.

Batch melting is used and molds are poured at three periods during the day, each mold by two ladle men, metal being transported to pouring stations at the end of each conveyor by means of two-wheeled bogies of 500 lb. capacity. The metal is melted in a 20-ton air furnace using pulverized coal.

Straightening is carried out to correct any settling or distortion which may have occurred during annealing, and is effected by heating castings to a temperature just below the critical point, *i.e.,* around 1200 F and squeezing each casting hydraulically between specially designed dies. A conveyor type furnace, using pulverized coal, makes this a continuous process.

A sand of medium grain size with a high clay content was found, after some experimenting, to be most suitable, and 5% additions of this sand, together with 5% coal dust, maintains a workable mixture. Average physical properties of the mixture are:—moisture, 6.5 to 7.5%; permeability, Nos. 35—40 A.F.A.; and green compression, up to 60 lb. per sq. in. from test samples taken at the mill.

Moisture content may be considered high, but moisture tests taken at the hopper mouth above the molding machines show a decrease of up to 1%. Drying-out varies, of course, with prevailing weather conditions and with the temperature of the sand in circulation. During peak molding conditions sand temperature at the mill rises as high as 86 F, due to using sand from recently cast boxes.

This foundry, highly mechanized, but using inexperienced labor, was able to produce 3,000 sound castings per week with few rejections. (A. B. Bill & J. Peers. *Foundry Trade J.,* Vol. 79, May 23, 1946, pp. 75-81; May 30, pp. 113-116.)

Purchasing Castings

Condensed from "Purchasing"

Purchasing departments can aid in identifying materials by specifying that part numbers should be made integral parts of molds, dies, patterns, and casting forms so that the number will appear in raised numerals, or, if this cannot be done, impression marking be substituted; part numbers should be so located that they remain untouched after all machining has been completed. When more than one type of material is used for a part, the different materials should be distinguished by identifying paints; and if one part number is made from a casting at one time and a forging at another, the two fabricating methods should be differentiated by symbols.

Other points to specify are that multiple castings and forgings should be stamped so that every part made from the original piece will have a part number; the numbers listed for castings and forgings should be consistent; vendor's name, brand, or trademark should be stamped on every piece; and heat or lot numbers should be stamped on the pieces whenever possible.

Receiving and storing of castings and forgings can be expedited by arranging to have them shipped on pallets and skids or in special containers. These should be sent to the vendors.

Sample pieces should be marked plainly as such and have the names of the recipients in the plant marked on them. They should not be sent to stores.

Purchase order for new castings or forgings should indicate that the parts are new. Often these require more precise and accurate inspection than would be required ordinarily.

Delivery dates should be specified so that the pieces will be received in an even flow spread over the entire working week. When large difficult-to-store castings are ordered, they should be received so that storing period is kept to an absolute minimum. Large castings should be delivered to waiting machines as soon as received.

Weight of individual pieces should be noted on purchase orders to provide a check against receiving. Where weight of shipment, number of pieces counted, and weight per piece are known, all three factors can serve as quantitative checks.

The best safeguard against incorrect receiving is to have the vendor mark container with his name, purchase order number, quantity shipped, part number, pattern or forging number, gross and net weights, and any other facts that will aid in identifying the shipment. (Benjamin Melnitsky. *Purchasing,* Vol. 20, May 1946, pp. 109-111, 380, 382.)

Injection Molding of Steel

Condensed from "Steel"

Steel injection molding presses are manufactured similar to those used for plastics, except that an Ajax Northrup high frequency induction heating unit is used and the unit is made of more expensive metals to resist high heat. Molten steel is fed into its injection tube hopper by means of a tilting furnace, in which the induction heating unit has been incorporated. Then it is forced from the injection tube into a closed mold by an actuating ram with hydraulic pressure from an injection cylinder.

Because of the high temperatures (2800 F min.) that must be withstood by these units, the ram has a tungsten carbide tipped face and the nozzle is made from high chromium heat resisting steel.

Molds or dies are made from drop forged steels, and the respective parts are mounted on fore and aft platens in the press. The front platen, which contains the injection nozzle, is stationary; the rear platen, which supports the cavity block, is movable and equipped with an ejector bar which will throw finished pieces into a suitable chute.

Except for the clamping and injection cylinders, all parts of the hydraulic apparatus are installed in the base of the press. These include a 120-gal. fluid tank.

The action of the electromagnetic force on the molten metal charge keeps the metal

PAY LESS for PAY LOADS

Crucible Steel Castings Co., Milwaukee, Wis., uses two 48" x 72" Wheelabrator Tumblasts, each of which cleans 40 to 45 tons of castings daily. One machine cleans green castings, the other annealed castings.

Whenever you see the Wheelabrator at work you will marvel at the mountainous pay loads it turns out with perfect ease and dispatch. And if you will check into cleaning cost records you will find even more to excite your enthusiasm.

But let us suggest that you go a step further and ask for a demonstration of the Wheelabrator on your own work . . . the tangible proof of its value to you in better cleaning, time and cost saved, and other factors may amaze you even more.

Arrangements for such a test can be made at your convenience and without the slightest obligation. Write, wire, or phone us today.

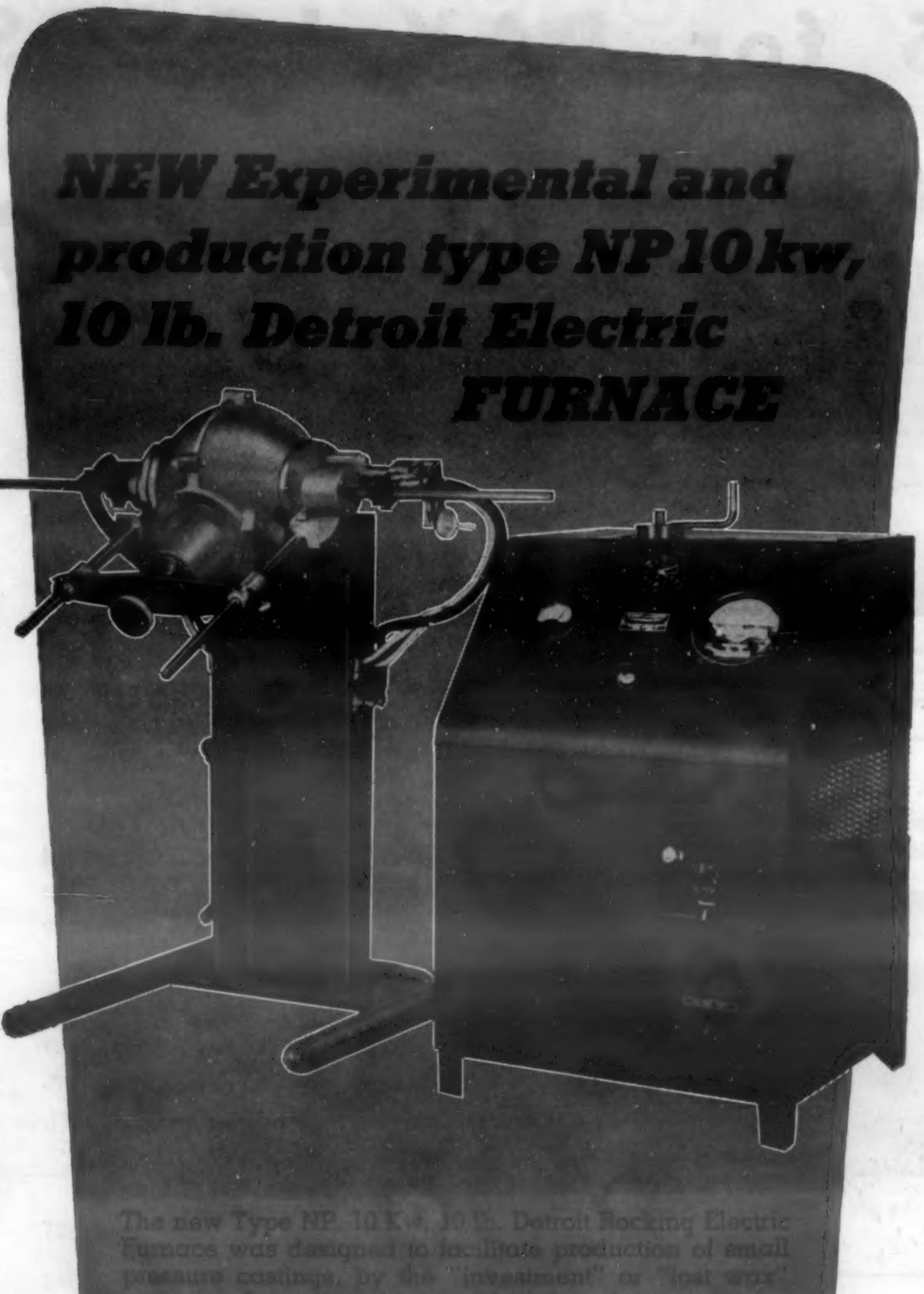
This No. 3 Wheelabrator Table is used in the plant of a prominent aircraft engine builder.

4 hours were formerly required to tumble 3 of these castings at Premier Furnace Co., Dowagiac, Mich. (Note the small castings being cleaned with the large one.)

These 120 lb. railroad castings are cleaned in a Wheelabrator Special Cabinet. Previous cleaning cost was 17.1c each. Present Wheelabrating cost is 8.4c each.

American FOUNDRY EQUIPMENT CO. 538 S. BYRKIT ST. MISHAWAKA, IND.

WORLD'S LARGEST BUILDERS OF AIRLESS BLAST EQUIPMENT



stirred up, quickly distributing the ele-ments to all parts of the charge, and thus insuring perfect homogeneity even at high speeds.

The first steel injection press was made for Armstrong Vickers at Birmingham, England, for use in making hypodermic needles. Prior to that time the manufac-ture of hypodermic needles was accom-plished by machining. With the new ma-chine, it was possible to turn out flawless needles at the rate of 6 per min.

Other articles that have been econom-ically made by steel injection molding in-clude carburetor cases, spark plug bases, wrenches, knobs, handles and small auto-mobile parts. None of these parts weigh over 15 lb., but it is believed that larger parts can be produced as soon as larger presses are available. (S. M. Milanowski, *Steel*, Vol. 118, May 27, 1946, pp. 86, 87-128, 130.)

Hot Tears

Condensed from "The Foundry"

The term "internal hot tear" is applied to a crack-like defect that commonly occurs in steel castings. This defect is not visible to the eye and thus is distinguished from the "external hot tear" which appears on the casting surface and extends toward the interior.

External hot tears have a rough, irregular appearance and form in castings soon after the metal has been poured. They are caused by interference with the normal contraction of the castings. This interfer-ence may be the result of one of two things—mold resistance or resistance due to the design of the casting where one part is restrained from contracting by other parts of the casting.

In addition to the presence of stresses which restrain contraction, one other con-dition must exist before an external hot tear can occur: a region must be present in the casting which is lower in strength than the rest of the casting. This weak area is usually the hottest part of the casting and is the point at which elongation or failure must occur.

Hot areas are found at the gates or risers of the casting, at internal corners, or in heavy sections which are joined to lighter sections. If a hot weak area is present, the deformation for the entire casting will occur at this localized area and may result in a hot tear.

Internal hot tears are found in imper-fectly fed castings. They differ in appear-ance from the external tears in that they have no particular orientation, may run in all directions, and usually have small cracks branching off from the larger cracks. Since the internal crack is invariably near a shrinkage cavity or a low density area, it is apparent that they are associated with shrinkage.

Radiography has been found to be the only reliable means of detecting internal tears, although it is probable that very severe internal tears, which extend to with-in a short distance of the casting surface, can be found by magnetic powder testing methods if a very high current is used.

DO YOU NEED A BETTER REFRACTORY?

● Corhart Electrocast Refractories are high-duty products which have proved considerably more effective than conventional refractories in certain severe services. If your processes contain spots where a better refractory is needed to provide a balanced unit and to reduce frequent repairs, Corhart Electrocast Refractories may possibly be the answer. The brief outline below gives some of the basic facts about our products. Further information will be gladly sent you on request.

Corhart Refractories Company, *Incorporated*, Sixteenth and Lee Streets, Louisville 10, Kentucky.

"Corhart" is a trade-mark, registered U. S. Patent Office.

PRODUCTS

The Corhart Refractories Company manufactures Electrocast refractory products exclusively. Corhart Electrocast Refractories are made by melting selected and controlled refractory batches in electric furnaces and casting the molten material into molds of any desired reasonable shape and size. After careful annealing, the castings are ready for shipment and use.

Three Electrocast refractory compositions are commercially available:

CORHART STANDARD ELECTROCAST — a high-duty corundum-mullite refractory, with density of approximately 183 lbs. per cu. ft.

CORHART ZED ELECTROCAST—a high-duty zirconia-bearing aluminous refractory, with density of approximately 205 lbs. per cu. ft.

CORHART ZAC ELECTROCAST—a high-duty zirconia-bearing refractory, with density of approximately 220 lbs. per cu. ft.

Other Corhart products are:

CORHART STANDARD MORTAR—a high-temperature, high-quality, hot-setting cement for laying up Electrocast, or any aluminous refractory.

CORHART ACID-PROOF MORTARS — rapid cold-setting, vitrifiable mortars of minimum porosities.

CORHART ELECTROPLAST—a high-temperature, hot-setting plastic refractory, designed for ramming and made from crushed Standard Electrocast.

CORHART ELECTROCAST GRAINS—Standard Electrocast crushed to desired screen size for use in many commercial applications.

PROPERTIES

Due to the unique method of manufacture, the Electrocast refractory line possesses a combination of characteristics found in no other type of refractory. Data on properties will be sent on request.

POROSITY: Apparent porosity of Corhart Electrocast refractories is practically nil—therefore virtually no absorption.

HARDNESS: 8-9 on Mineralogist's scale.

THERMAL EXPANSION: Less than that of conventional fire clay bodies.

THERMAL CONDUCTIVITY: Approximately one and one-half times that of conventional fire clay bodies.

REFRACTORINESS: Many industrial furnaces continuously operated up to approximately 3000° F. are built of Corhart Electrocast.

CORROSION: Because of exceedingly low porosity and inherent chemical compositions, Corhart Electrocast refractories are resistant to corrosive action of slag, ashes, glasses, and most non-ferrous metals as well as to disintegrating effects of molten electrolyte salt mixtures.

APPLICATIONS

Most heat and metallurgical processes present spots where better refractory materials are needed, in order to provide a balanced unit and reduce the expense of repeated repairs. It is for such places of severe service that we invite inquiries regarding Corhart Products as the fortifying agents to provide the balance desired. A partial list of applications in which Corhart Electrocast products have proved economical follows:

GLASS TANKS—entire installation of sidewalls and bottoms, breastwalls, ports, tuckstones, throats, forehearths, bushings, bowls, recuperators, etc., for lime, lead, opal and borosilicate glasses.

ELECTROLYTIC CELLS—for production of magnesium and other light metals.

SODIUM SILICATE FURNACES — sidewalls, bottoms, and breastwalls.

PIGMENT FRIT FURNACES—complete tank furnaces for melting metallic oxides and salts for pigment manufacture.

ALKALI AND BORAX MELTING FURNACES —fast-eroding portions.

BOILERS—clinker line.

RECUPERATORS—tile, headers, separators, etc.

ENAMEL FRIT FURNACES—flux walls and bottoms.

BRASS FURNACES—metal contact linings.

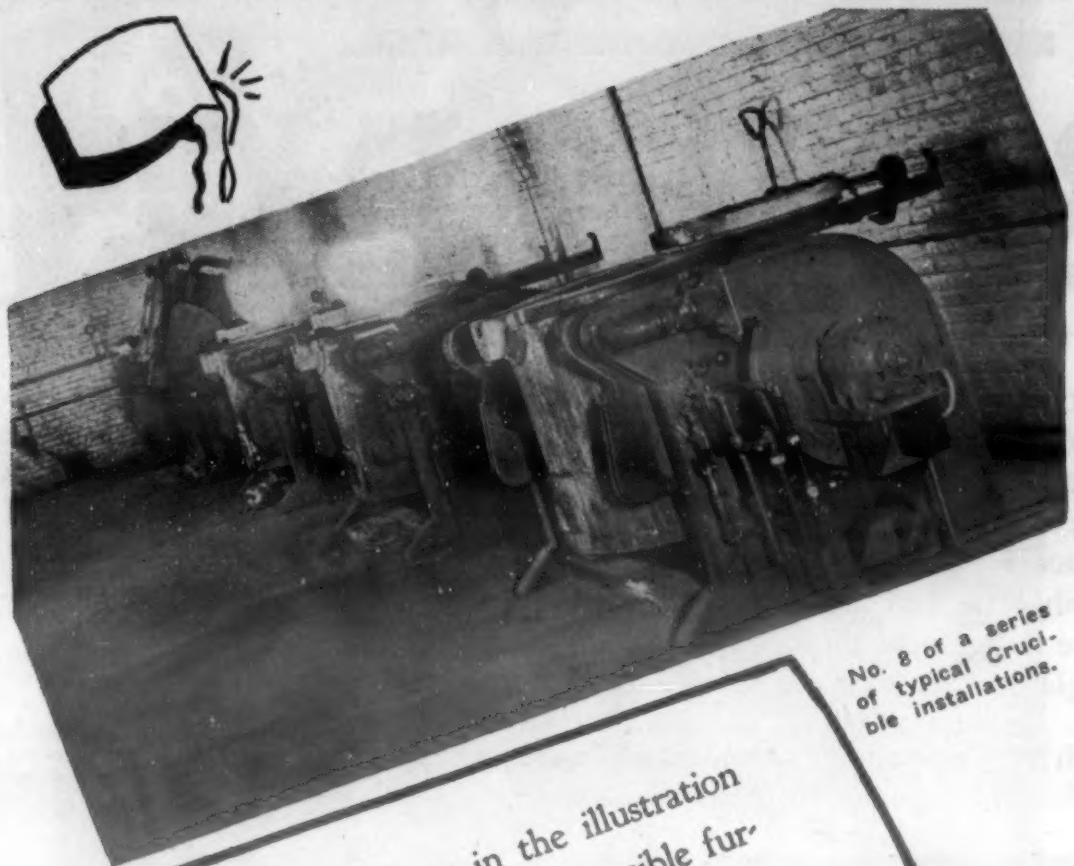
ELECTRIC FURNACES—linings for rocking type and rammed linings of Electroplast for this and other types.

NON-FERROUS SMELTERS—complete hearths, sidewalls, and tapping hole portions.

QUALITY ECONOMY ENDURANCE

CORHART ELECTROCAST REFRACTORIES

A MODERN CRUCIBLE FURNACE INSTALLATION



No. 8 of a series of typical Crucible installations.

The furnaces in the illustration are oil fired. Similar crucible furnaces can be operated with gas or coke fuel. When using such furnaces, the fuel cost stops when the operator turns off the supply. There are no "stand-by charges" when the furnaces are idle.

For lowest investment, operating economy, flexibility and sound castings install Crucible furnaces.

Write for Crucible Melters' Handbook; mailed free.

Five hydraulically tilted, nose-pour brass melting furnaces using No. 400 crucibles. Photograph taken in plant of Republic Brass Co., Cleveland, Ohio. Capacity 24,000 to 30,000 lbs. red brass per eight hour day. Requires only three men to operate furnaces.

CRUCIBLE MANUFACTURERS ASSOCIATION

90 WEST STREET, NEW YORK 6, NEW YORK

The magnetic powder test is ideally s for detecting external tears.

External hot tears are eliminated e by the judicious application of chills brackets which strengthen the metal, ing it capable of resisting the tearing ses, or by using weak sand or relie cavities which enable the mold to coll thereby relieving the stresses. Internal tears are eliminated by any of the m that are used to prevent shrinkage. (H. Bishop & H. F. Taylor. *Foundry*, Vol. July 1946, pp. 82-87, 218.)

High-Strength Aluminum Bronze Castings

Condensed from "Foundry Trade Journ

If aluminum content in the copper-al minum alloys is higher than 9.8%, th castings normally cooled will contain de constituent, which is very fragile. T aluminum content should be such as to e sure in the final structure after heat-tre ment a suitable percentage of the alp and beta constituents.

The more the alpha constituent is prese in the final structure, the higher the m leability of the metal and the greater th elongation, with distinct detriment to th tensile strength. On the other hand, th more of the beta constituent present, th lower the elongation and the greater th tensile strength.

The final contents of the alpha and be constituents will depend on the tempe ature chosen for quenching, which oug to be carried out between 1470 to 110 (800 to 600 C). In any case, quenchin should be carried out at a temperatur higher than 1058 F (570 C), so as t avoid the precipitation of the eutecto containing the delta constituent.

The various elements which can be adde to aluminum bronze have a more or le marked effect on the mechanical propertie Addition of iron (less than 4%) refine the structure and increases the tensil strength of 2 to 3 tons per sq. in. for eac percent added.

The presence of iron is of a real interes in castings required to have good prop erties at elevated temperature, because thi element retards the grain growth on heat ing. Manganese (0.2 to 0.3%) has beneficial effect as deoxidizer. It is be lieved that an addition of tin widens th solidification range of this alloy.

With normal composition of aluminum bronze, the freezing range is practicall zero, and, therefore, the making of thick sectioned castings is difficult. Tin increase the tensile strength, but lowers the elonga tion.

Read and Graves showed the "coefficien of equivalency" between tin and aluminum Thus, 1% of tin corresponds to 0.6% in the alpha field, and to 0.5% in the bet field. Tin increases the resistance to soft and sea water corrosion of aluminum bronze.

Nickel is used principally on account of its influence on the corrosion resisting properties. (J. Duport. *Foundry Trade J.*, Vol. 79, July 4, 1946, pp. 245-246.)

Refractory Concrete

THE ADAPTABLE REFRACTORY

CAST-IN-PLACE TO FIT THE JOB. Arches, skew-backs, tapered wall sections, jointless linings are formed in exactly the shape, size and location needed. No cutting and trimming of pieces, no patching up with bats and mortar.

Adaptable to **DESIGN** *requirements*

QUICKLY INSTALLED AS NEEDED. Refractory aggregates and LUMNITE are mixed with water and cast into forms or molds. LUMNITE is a rapid-hardening binder, so Refractory Concrete is ready for service in 24 hours or less.

Adaptable to **CONSTRUCTION** *requirements*

THERMAL PROPERTIES AS REQUIRED. Service characteristics—refractory limit, insulating value, heat storage—are determined by type of aggregate and proportions of mix. With LUMNITE and two or three low-cost aggregates in stock you have materials for a large variety of refractory jobs.

Adaptable to **SERVICE** *requirements*

Ready-To-Use

CASTABLE REFRACTORIES

Factory-prepared mixtures of LUMNITE and selected aggregates offer you a convenient means of making Refractory Concrete—simply mix with water and cast in place. Obtainable everywhere from distributors of Refractories.

Specify Castables

MADE WITH LUMNITE

LUMNITE DIVISION *

Universal Atlas Cement Company

(United States Steel Corporation Subsidiary)

Chrysler Building New York 17, N. Y.

*Formerly The Atlas Lumnite Cement Company

LUMNITE FOR REFRACTORY CONCRETE

FABRICATION and TREATMENT

Machining, forging, forming, heat treating and heating, welding and joining, cleaning and finishing of solid materials. Methods, equipment, auxiliaries and control instruments for processing metals and nonmetals and for product fabrication.

Atomic Hydrogen Welding

Condensed from "The Welding Journal"

Progress in the welding of light-gage materials used in the aircraft industry can be measured by increased knowledge of welding design, fuller utilization of existing welding facilities, and the introduction of special alloys used in the work.

The methods now in use with the atomic hydrogen welding process demand a slower welding speed than was used earlier, yet this is still a little more than twice as fast as the oxyacetylene method. The use of the "silent arc" has become standard because of the finer control that is obtained.

Higher hydrogen pressures are used in tacking, as well as a higher current since, as is common in most tacking operations, a high heat is required to bring the metal temperature up quickly to develop a small weld without distorting the assembly. The tungsten electrodes are adjusted so that the arc fan can be rotated to almost any desired angle.

Types of joints welded with this process include: lap, fillet, butt, flange, seam, edge and corner.

The major function of a welded joint is the final bond obtained after welding is complete, its soundness, strength and fatigue resistance characteristics.

Atomic hydrogen welding is used on stainless steel and in the welding of low carbon steel sheet combatable with enameling materials. This method offers an excellent means of joining thin gage materials on both irregular and closed angle welding.

The narrow weld bead affords easier determination of the soundness of the weld, visual inspection is made easier, and indicates a fine degree of operator control. (Frederick S. Dever. *Welding J.*, Vol. 25, Apr. 1946, pp. 309-312.)

Oxide Coatings On Aluminum

Condensed from "Sheet Metal Industries"

The application of oxide coating to aluminum falls into two classes: (1) those produced by immersion in suitable oxidizing solutions, (2) those in which the oxidation is carried out by electrolytic methods. Typical examples of the first class are: (a) Modified Bauer-Vogel (M.B.V.) Process, (b) "Alrok" process, and (c) "Pylumin" process.

The number of electrolytic processes is very much larger, but they may be generally divided into three classes, using electrolytes based on three different acids. Typical examples are: (a) Bengough-Stuart process using chromic acid, (b) "Alumilite" process using sulphuric acid, and (c) "Eloxal" using oxalic acid.

The material to be treated is first chemically and/or mechanically cleaned to insure optimum processing results. It is then oxidized or anodized by the process selected and becomes coated with a layer of aluminum oxide, the color of which will vary from a transparent silver finish to a deep slate gray, depending both on the composition of the aluminum and on the oxidizing process.

When the oxide film has been formed it is capable of absorbing oils, waxes, dyestuffs, etc., and it is usually necessary to give a final treatment, which will depend upon the ultimate function of the coating and the service conditions under which it will be used. The corrosion resistance of oxide coatings depends upon the continuity of the film, and up to the point where production of thick films begins to give rise to difficulties based upon the solubility of the oxide films in the solutions in which they are formed, the corrosion resistance is approximately proportional to the thickness.

Generally speaking, anodized aluminum is resistant to fairly neutral compounds that are free from heavy metals or free from halogens. Oxide films are harder than the base metal, but they are not very resistant to impact. The chemical oxide films have little resistance to wear; however, the films produced anodically, especially those produced in sulphuric and oxalic acid, show excellent wear resistance.

Apart from the effect of the raw material and of the selected oxide coating processes on the general results obtained, there are certain general considerations to be remembered: (1) Oxide coating should be carried out at as early a stage as possible, and the treatment of assemblies should be avoided; (2) components containing a mixture of dissimilar metals should not be treated; (3) materials that give rise to a prominent grain after oxide coating should be cut and assembled so that the grain follows the symmetry of the job, or one of the obscuring surface preparation methods should be employed; and (4) it has been found that when sheet metal workers consult with the finishing groups while the work is still at the blueprint stage, most of the difficulties enumerated can be overcome. (V. F. Henley. *Sheet Metal Inds.*, Vol. 23, Aug. 1946, pp. 1561-1567.)

Shotpeening

Condensed from "Western Machinery and Steel World"

Shotpeening, formerly called shotblasting, was originally developed to increase the fatigue resistance of steel automobile springs. Its use has greatly expanded during the war, especially to aircraft engine components and other highly stressed parts.

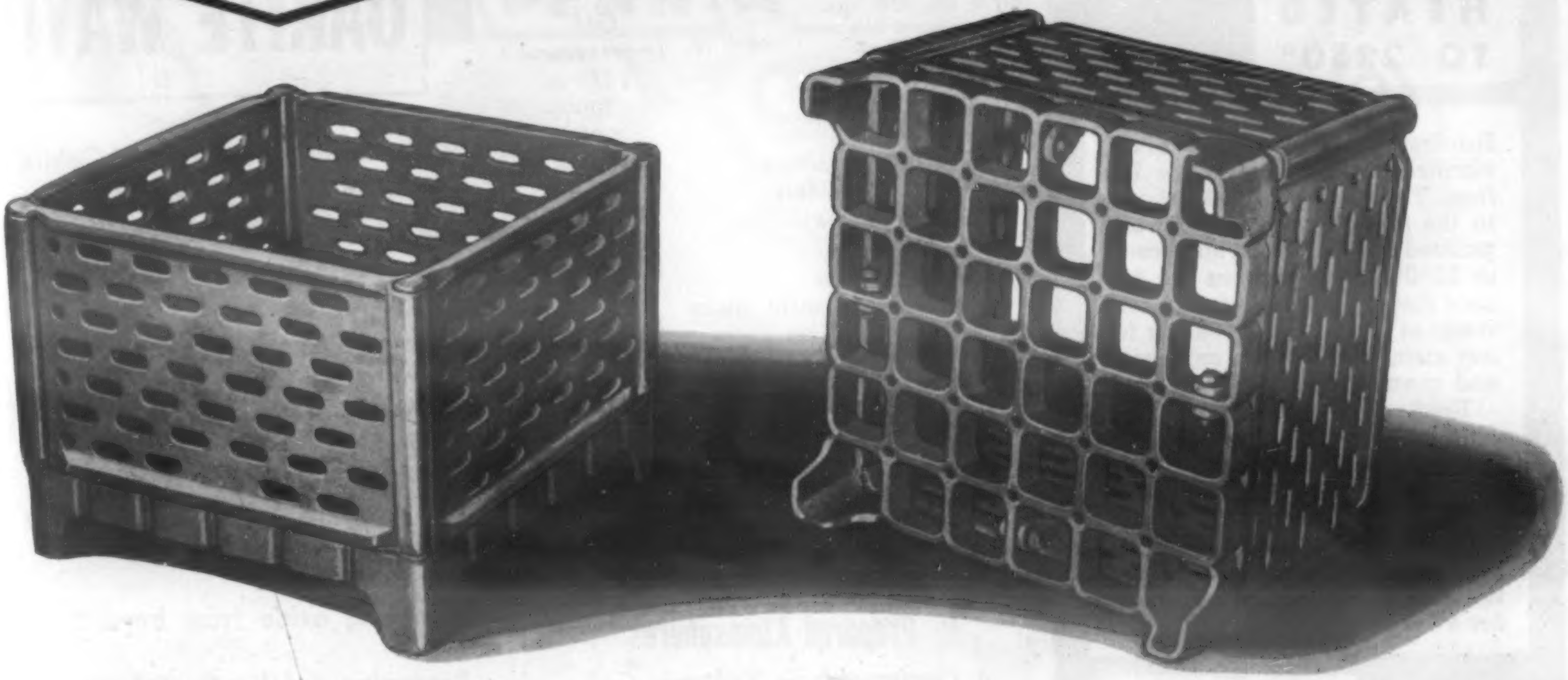
While the shotpeening operation and its equipment resembles blast cleaning, they should not be confused. In shotpeening the time, size and velocity of the steel shot are adjusted according to the size, shape and hardness of each particular part.

A BOON TO HEAT TREATERS

X-RAY CONTROLLED

THERMALLOY

HEAT AND CORROSION RESISTANT FLEX BOXES



K-36

Cracking and buckling due to metal expansion and contraction when subjected to elevated temperatures and sudden cooling, are reduced to a minimum in the Flexbox—it is designed to compensate for changes in dimensions when the temperature varies.

Engineering design thus takes its place with metallurgy and sound foundry practice in the production of THERMALLOY.

AMSCO ALLOY and THERMALLOY are identical

MUFFLES
RETORTS
BASKETS
POTS
CHAIN
TRAYS

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION

ELYRIA, OHIO

Demonstrating
BRICKSEAL
REFRACTORY COATING

Brickseal provides a crackproof, vitrified armor for furnace linings. The small firebricks shown in the furnace were bonded and painted with Brickseal and heated to 2250°. Directly from the furnace they were plunged into cold water as shown below—a test for *any* material subject to expansion and contraction.

Brickseal is ***semi-plastic when hot***, yet ***hard and tough when cold.*** Brickseal is made in grades suitable to heats ranging from 1400° to more than 3000°. It will make any furnace last longer by giving new life to your refractories. Write or call local dealer for a demonstration.

BRICKSEAL
REFRACTORY COATING
5800 S. Hoover St., Los Angeles, Cal.
1029 Clinton St., Hoboken, N. J.

While the result can be measured by use of a special gage, much depends on the experience of the operator in choosing the proper time, size of shot and velocity because sufficient data has not been tabulated to make this increasingly important metalworking operation "cut and dried."

The fatigue, shock and corrosion resistance of highly stressed parts are greatly improved by setting up protecting compressive stresses on the surface. Because of the increase of allowable stresses the savings in material often pays for this cheap operation, and this should be kept in mind by the designer. Although most of the experience has been with steel parts, other materials have been successfully shotpeened.

Grinding removes the effect of shotpeening but honing does not, and often the small indentations made by the peening balls act as oil pockets and are beneficial to lubrication.

Typical examples of the increase in useful life of parts caused by shotpeening are given below:

Type of Part	*Life Improvement*
Helical springs	1370%
Leaf springs	1300%
Crankshafts	900%
M-1 rifle extractors	760%
Firing pin holders	680%
Gun extractors	650%
Hypoid gears	600%
U-joint crosses	520%
Transmission main shafts	520%
Steering knuckles	475%
Welded joints	310%

(*Western Machinery & Steel World*, Vol. 37, July 1946, pp. 100-102.)

Prepared Atmospheres

Condensed from "Industrial Gas"

Single installations of the special equipment usually required for atmosphere generation range in size up to capacities of more than 2.5 million cu. ft. per day. Single generators are now made which produce from 250 to 25,000 cu. ft. per hr. of certain types of atmospheres.

Today there is a pronounced tendency toward not only separate preparation of the atmosphere, namely in a special generator, but also to keep the atmosphere separate in the furnace. This conserves the atmosphere and permits maintaining more constant control of its chemical constituency, hence the results attainable.

There is a two-fold use of gas in many furnaces, one for the atmosphere and one for heating the furnace charge. The radiant tube type of furnace was largely responsible for this development. Applications are in two broad fields: prevention of changes in the surface of the metal during treatment, and causing purposeful changes in surface conditions along desired lines.

The war brought numerous improvements in the nature of the gases — their chemical constituency, which served to increase productive rates and to control their effectiveness more closely.

On Aluminum and Brass . . .

Deoxidize and Remove Smut

THE NEW LOW-COST OAKITE WAY!

With the new plant-tested Oakite Compound No. 34, metal finishers can now smooth out tough processing wrinkles . . . cut costs in such operations as:

Deoxidizing and removing smut from aluminum alloys before spot-welding

Deoxidizing aluminum before anodizing

Removing oxide from brass

Producing a delicate etch on aluminum surfaces for effective paint adhesion

If you are anxious to speed any of these operations, call the Oakite Representative in your locality NOW! He will gladly test-run this new material on your production line to show you how it can save for you! His services are free, without obligation! Or write on letterhead direct for technical advisory data!

OAKITE PRODUCTS, INC.
34E Thames Street, New York 6, N. Y.

Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *Specialized* **CLEANING**
MATERIALS • METHODS • SERVICE

PENN SALT

If you have a problem in metal cleaning, electroplating, enameling, corrosion, acid-proof construction..... get in touch with the Pennsylvania Salt Manufacturing Company, *Chemicals*, 1000 Widener Building, Philadelphia 7, Pa. • New York • Chicago • St. Louis • Pittsburgh • Cincinnati • Minneapolis • Wyandotte • Tacoma

Industrial Furnaces

We Manufacture Furnaces For

Air Tempering
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Brass Holding
Brazing
Bright Annealing
Carburizing
Continuous Process
Cyaniding
Drawing
Enameling
Forging
High Speed Hardening
Lead Hardening
Lead Melting
Nitriding
Normalizing
Oil Tempering
Preheating
Salt Drawing
Special Process

For Every Purpose

For many years the American Electric Furnace Company has been pioneering, developing, manufacturing and shipping industrial furnaces to all parts of the world.

We have solved many difficult problems and are continually solving others as the demands of industry present them. We may be able to solve your problem . . . at substantial savings. Why not write us today and take advantage of our experience?

Electric — Gas Fired — Oil Fired.

American Electric Furnace Company
29 Von Hillern St. Boston, Mass., U. S. A.
Industrial Furnaces for All Purposes

"Skin recovery," or carbon restoration — the wartime development which seems most significant at this time — is the use of atmospheres to restore the surface carbon in carbon-depleted steel, applicable for both carbon and alloy steels. The carbon content has been reduced when the metal has been heated for forming, such as rolling, swaging, forging, etc. Sometimes steel just received from the mill has its carbon depleted and it must be restored.

Previously, in cases of carbon depletion, is was necessary to machine away the surfaces, a costly and now unnecessary practice. The carbon can now be put back into the metal to almost exactly its original content. Many thousands of new aircraft parts which otherwise would have had to be scrapped were salvaged by this process.

Controlled atmospheres can prevent carbon depletion in the first place. Thus, in heating for forging the parts of hollow steel propeller blades through a total of 65 hot-forming operations an enriched nitrogen atmosphere protects them against loss of surface carbon. Some parts are heated four or more times at 2250 to 2400 F and still this protection is effectively provided.

Some problems still remain relative to handling thin sheets, but these appear well on the way to solution. During the war thousands of large alloy steel gears for military tanks were completely machined to close limits by the extremely precise gear shaving process prior to heat treatments. They were then carburized, reheated, die-quenched in oil, and drawn.

No subsequent operations were necessary on the tooth surfaces other than light cleaning by shot blast. The gears were nearly 2-ft. in dia. The depth of carbon penetration was closely controlled.

Gas quenching fills a gap between oil quenching and normalizing. By controlling the rate of flow of water-cooled atmosphere gas over the surfaces of the material, the rate of cooling can be changed within defined limits. By adding a furnace beyond the quenching zone the material can be given an accelerated aging treatment. (E. G. de Coriolis. *Ind. Gas*, Vol. 25, July 1946, pp. 10, 11, 24 & 26.)

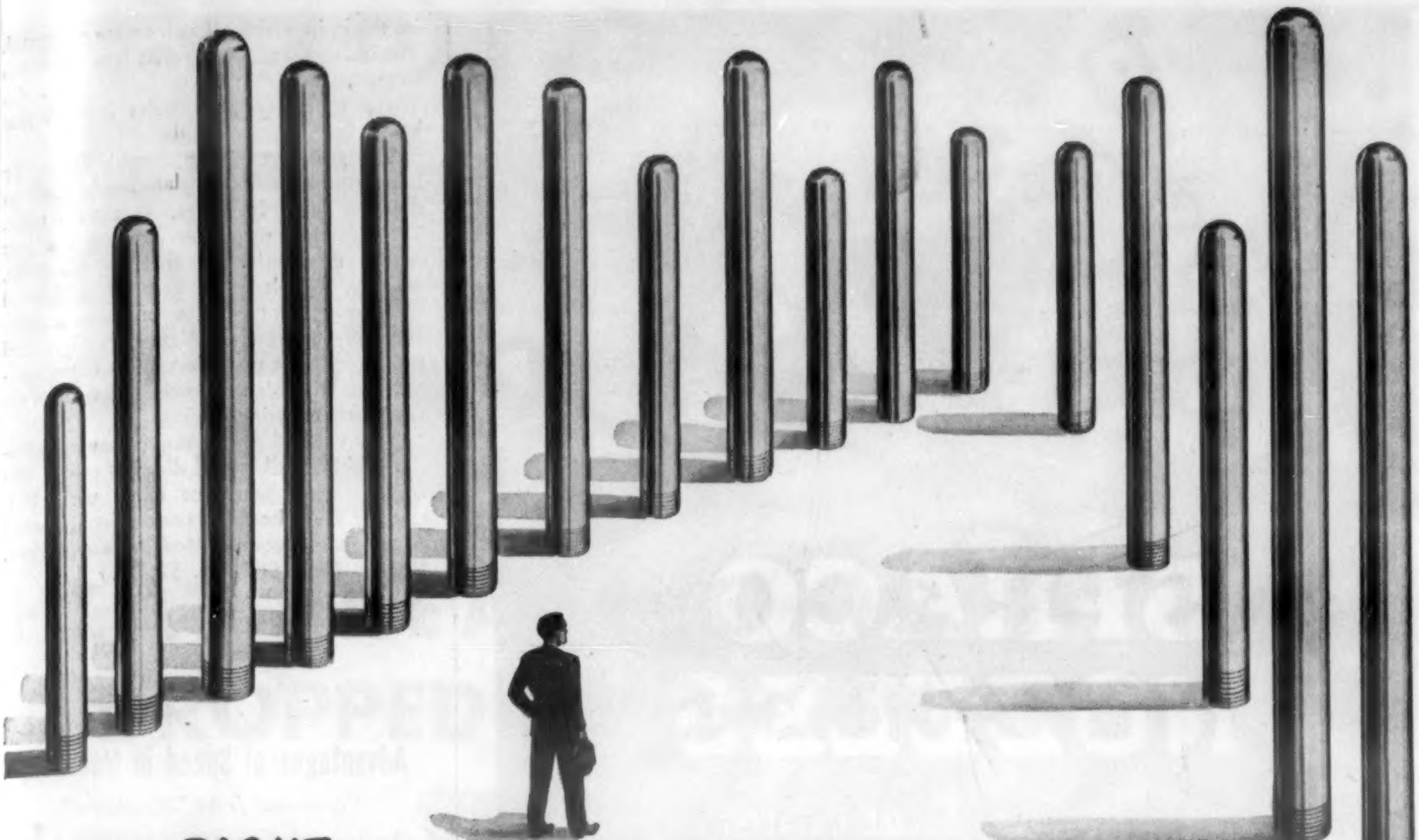
Punched Gears

Condensed from "Modern Industrial Press"

Among the many parts made by the Shakeproof Div. of Illinois Tool Works, Chicago, during the war, was a bomb fuse for arming aerial bombs of all types. Ruggedness was one of the prime requirements of the fuse assembly.

A two-bladed spinner, powered by the force of the air as the bomb drops through space, turns a series of gears which make up the fusing apparatus. This reducing-gear assembly, made to tolerances of 0.001 in., fitted into a dia. little larger than a teacup and a little deeper than a saucer.

Since speed rather than cost was a prime factor in producing these parts, some method other than machine cutting was desired. Stock used was ¼-hard brass, ⅛-



Pick the *RIGHT* thermocouple protection tube to minimize interruptions in temperature measurements

Prevent operating interruptions caused by thermocouple protection tubes that can't "take it."

Standardize on long-lasting Inconel* tubes wherever possible.

Inconel seamless, drawn tubes stand temperatures up to 2200° F. in sulfur-free atmospheres...are not embrittled by hydrogen-nitrogen mixtures...do not scale away through oxidation...resist chemical attack by carburizing media, nitriding atmospheres and fused salt baths...take rough handling ... offer greater impermeability to gases harmful to thermocouples.

Because of their resulting longer life, Inconel tubes actually cost less in the long run than the tubes you're now using. Thus, at no extra cost you gain greater freedom from temperature-control interruptions plus a *quicker, accurate response* to temperature changes.

Make this test! When it comes time to replace any of your present tubes, try one made of Inconel. You can prove to yourself the longer service and quicker response obtained with this high-Nickel alloy.

Seamless, drawn Inconel protection tubes are available in standard diameters, with one end closed and the other end threaded. Write for more information on Inconel.

*Reg. U. S. Pat. Off.

YOUR REGULAR SUPPLIER OR INSTRUMENT MANUFACTURER CAN FURNISH INCONEL PROTECTION TUBES IN ANY SIZE AND LENGTH WITH EITHER STANDARD OR EXTRA-HEAVY WALL THICKNESS

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall St., New York 5, N. Y.

INCONEL ***...for long life at high temperatures***

(80 NICKEL-14 CHROMIUM)

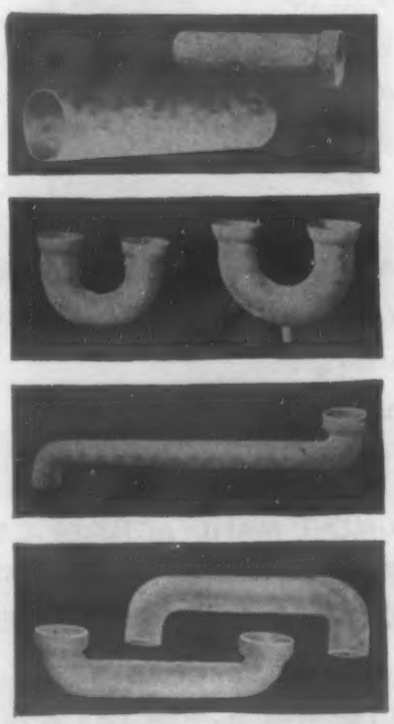
SPRACO NOZZLES

Write for NOZZLE CATALOG *to*

SPRAY ENGINEERING CO.

109 CENTRAL STREET • SOMERVILLE 45, MASS.

NOW A MUCH NEEDED ENGINEERING SERVICE



Heretofore the design and selection of silica ware units, for processes involving extreme temperatures and highly corrosive conditions, has been on the basis of fitting various pieces of equipment together.

Amersil now offers an engineering service which includes development, research, design, controlled manufacture of major silica ware units, selection and purchase of auxiliaries, all under one contract one responsibility.

Because of this integrated design and manufacturing service, Amersil is able to guarantee performance.

AMERSIL COMPANY Inc.

ENGELHARD

CHESTNUT AVENUE HILLSIDE 5, N. J.

in. thick, in which all holes were perforated. The pilot hole, from which the work was located, was shaved to a 0.350-in. dia. There were two such holes in each gear blank.

The gears were then roughly formed by blanking. Two finishing shaves, gaged from the two 0.350-in. holes, were then made. This shaving operation brought the gear within the limits specified for pitch dia. reading. Result was a gear which fulfilled the requirements of the ordnance experts. Use of progressive dies and high-speed presses made it possible to turn out production much faster than would have been the case with machine cutting.

This method of successive shaving operations with punches and dies has possibilities in producing gears for many uses. It is cheaper than the more conventional method of producing gears. (*Mod. Industrial Press*, Vol. 8, July 1946, pp. 32, 34.)

Advantages of Speed in Machining

Condensed from "Mécanique"

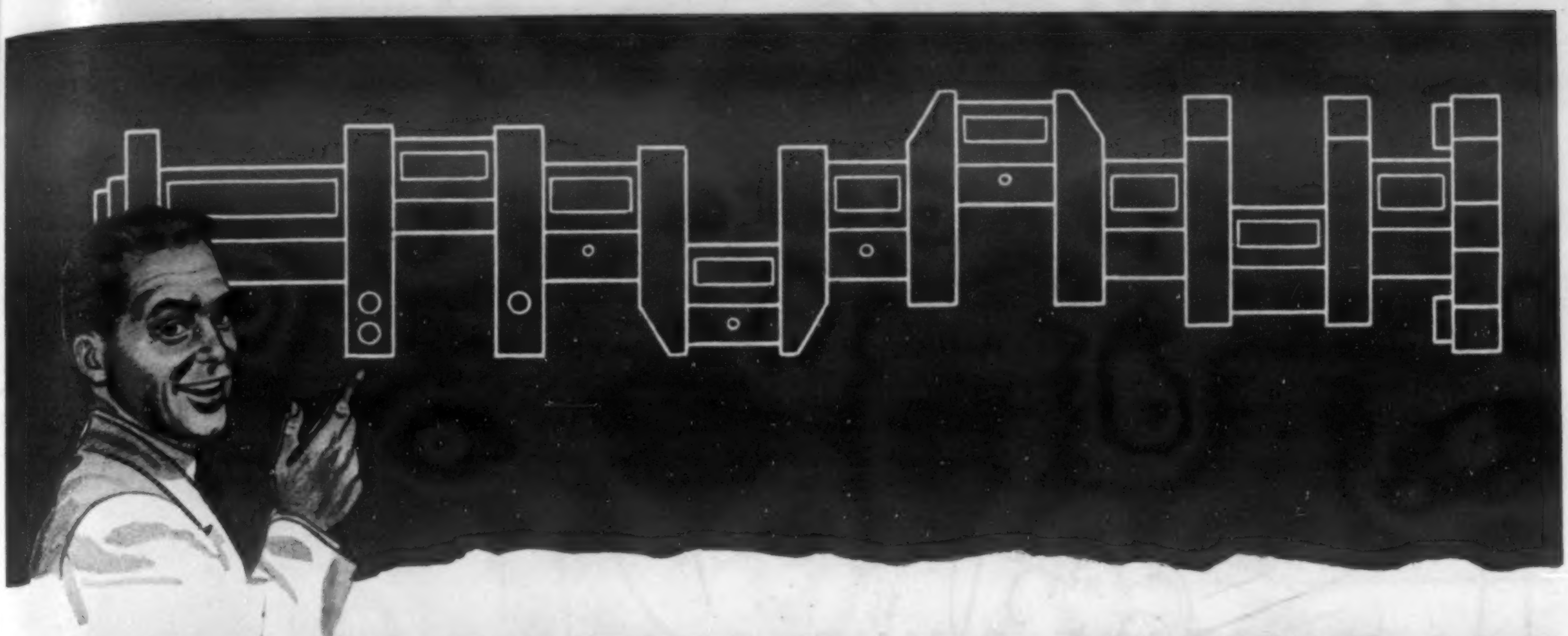
An increase in speed may not only save time but also prevent certain related phenomena which require time for their occurrence. A noteworthy application of this elementary principle is found in modern machining practice. For example, the high speed made possible by the use of carbide tools has many related advantages: (1) no built-up edge is formed because of the brief contact between the tool and the material being cut; (2) there is no time for secondary vibrations; (3) power cosumption is decreased while tool and machine life is increased; (4) a better finish is obtained; and (5) the high speed causes heating and softening of the surface of the material being cut so that removal of chips is facilitated, while there is not enough time for much of the heat to be transmitted to the tool.

The advantages of carbide tools become particularly marked as the hardness of the material being machined increases. If carbide tools are being used in compression without oblique stresses, the contact with the material being cut should be as far away from the cutting edge as possible. Depths of cut at least as heavy as those for high-speed steel should be used. The cutting speed should be high enough to obtain the above advantages.

In milling, the introduction of negative rake and down milling has resulted in better power utilization, better finishes and less tool wear. As compared with positive rakes and up milling, the initial contact is away from the cutting edge, thus minimizing chipping and enabling a speed fast enough to heat and soften the surface of the material being cut. The negative rake is of interest only on hard materials.

In turning, the type of cutting and the chip form are entirely different from milling. The use of a negative rake is not satisfactory, as the cutting speed is then too slow to soften the material being cut.

It is very odd that it is really the "defect"



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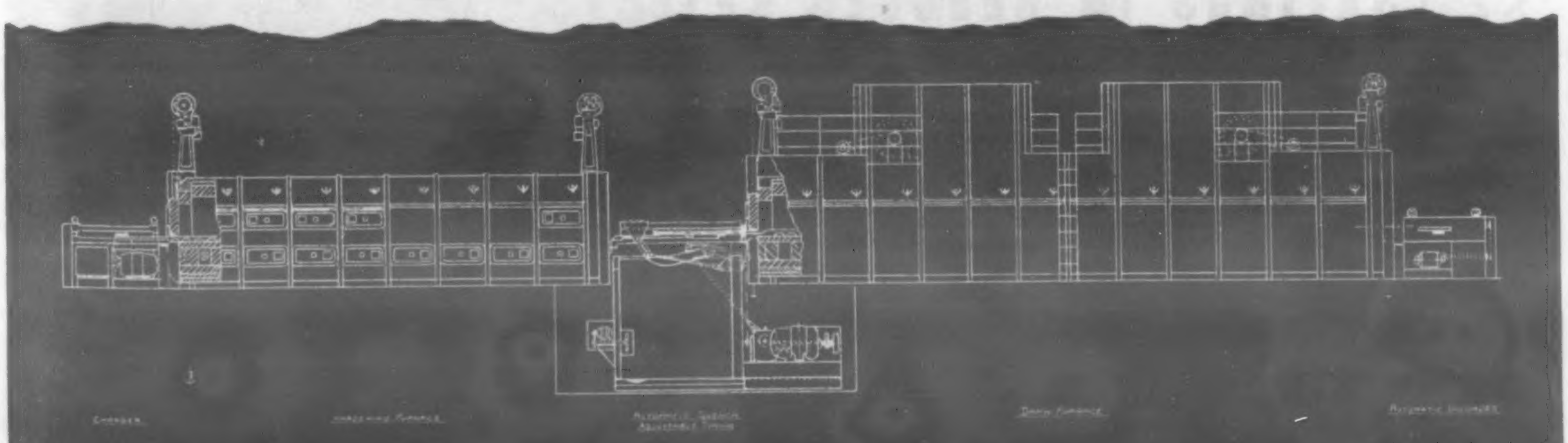

of brittleness in carbide tools that has led to astonishing results because it has forced the study of tool angles and the use of negative clearance angles. The war has completely modified the old machining methods by making use of the compressive strength of carbide tools in taking heavy cuts at high speeds.

It is hoped that new improvements might be realized in turning and planing tools if the brittleness of carbides could be overcome. The machine tool manufacturers will have to design and produce machines that will have the required power, speed and rigidity. (R. Delamare. *Mécanique,* Vol. 30, Feb. 1946, pp. 29-36.)

Effects of Heat Treatment on 18:8

Condensed from "Western Metals"

The Ryan Aeronautical Co. laboratory has recently concluded a series of investigations to determine the particular benefits, if any, which might be imparted by stabilizing and stress relief heat treatment upon welded 18:8 type 321 and type 347 stainless steels for use on exhaust manifolds. Benefits which would be reflected in greater serviceability of the aircraft exhaust manifolds manufactured from this steel were of prime importance to this inquiry.

When 18:8 type was first used on aircraft exhaust manifolds, it was soon discovered that the material was rapidly attacked by the exhaust gases. Closer investigation disclosed that the carbides formed were not resistant to the products of combustion encountered in the exhaust gases. This led to the use of stabilized grades type 347 and type 321 grades of 18:8.

Substantiating facts have been accumulated by the Ryan laboratories which show that exhaust manifolds will resist corrosion where a combined precipitate of columbium or titanium carbides and chromium carbides exists after sensitizing the annealed material.

No breakdown of the metal in the form of cracking or corrosion was noted, with the exception of an attack which had progressed to not over 0.005 in. on the inside surface of the body of the manifold. Yet, the photomicrograph showing the depth of the corrosive attack by exhaust gases quite conclusively indicates that the presence of the carbides, even with their continuity becoming more definite, does not contribute to an excessive cause for corrosive attack by the exhaust gases.

It is from these tests that we conclude that there is no correlation between the required accelerated corrosion tests as outlined by specification and actual service conditions. Some type of corrosive test is necessary to determine the susceptibility of the various grades of stainless steel to carbon precipitation.

The bend tests on the weld zone after embrittlement tests proved to be more satisfactory than was expected. All but one sample, which cracked during preparation,

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PROBLEM: To carburize SAE 1025 hedge shear blades to produce a 0.020″ case with Rockwell "C" 60 and no distortion.

SOLUTION: 90 minutes at 1600°F. in Aerocarb* Oil quench.

PROBLEM: To carburize SAE 1315 refrigerator crankshafts to produce a 0.035″ case with Rockwell "C" 60 and minimum distortion.

SOLUTION: 2¼ hours at 1700°F. in Aerocarb Deepcase—transfer to Aeroheat** 1200 at 1550°F. for 5 minutes—transfer to Aeroheat 300 at 345°F. for 5 minutes—air cool.

PROBLEM: To carburize C 1019 coupling pins to produce a 0.060″ case, Rockwell "C" 62 and minimum distortion.

SOLUTION: 4¼ hours at 1750°F. in Aerocarb Deepcase, transfer to Aeroheat 1200 at 1500°F. for 5 minutes, quench into water.

These typical applications provide a clear-cut demonstration of the versatility of Cyanamid's liquid carburizing compounds. Assistance in the proper choice and use of these materials may be had by contacting the nearest Cyanamid district office.

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withstood bending 180 deg. over a dia. equal to twice the thickness of the material, which was 0.043 in. Compression failures on the inside of the bend radius were noted in all specimens.

The results of the tests conducted by the Ryan laboratory have been crystallized into a conclusion that stabilizing treatment obtained by heating welded section of 18:8 types 321 and 347 stainless steel for 30 min. at 1650 F exerts some small, but inconclusively beneficial results, in one respect of minor significance—resistance to attack by corrosive aqueous solutions and electrolytes. (Wilson G. Hubbell. *Western Metals*, Vol. 4, July 1946, pp. 19-22.)

Magnesium Welding

Condensed from "Industry and Welding"

The Keen Manufacturing Corp. of Flatrock, Mich., manufactures a line of handling equipment and is now fabricating an appliance mover which is lighter and stronger than previous models. This new lightweight truck is made possible by the combined use of magnesium and arc welding. The various subsections are constructed of extruded magnesium, and these are welded together in the final assembly.

The equipment used in performing these welding operations consists of high frequency a.c. machines and water cooled welding torches. A combination of 1/8-in. and 5/32-in. magnesium welding rod is required for these joints and material thicknesses. This arc welding procedure involves the use of argon gas, which flows at the rate of 3 to 3½ liters per min.

In arc welding magnesium, the arc is maintained by one tungsten electrode, which provides the heat for melting the filler rod. The rod is of the same alloy as the base metal. The filler metal and the arc are both shielded by the argon gas envelope to prevent oxidation during welding. The gas eliminates the need for any flux by keeping oxygen away from the point of welding. For these operations a current range of 100 to 125 amp. is normally used.

Because of the fluidity of magnesium, it is practical to weld only in the flat or vertical positions. This means that positioning jigs are essential. Warpage is another problem to be dealt with in welding this metal. All welding is done on special jigs, and the work is left in the jigs until completely welded.

The magnesium which Keen uses is shipped in the plain condition (not chrome-pickled) and, therefore, no special preweld cleaning operation is necessary. Any loose dirt clinging to parts is removed. After all welding is done, the high spots are ground down with rotary grinders. The finished products are stress relieved by holding them at a temperature of 350 F for 1 hr. (*Ind. & Welding*, Vol. 19, July 1946, pp. 40-42.)

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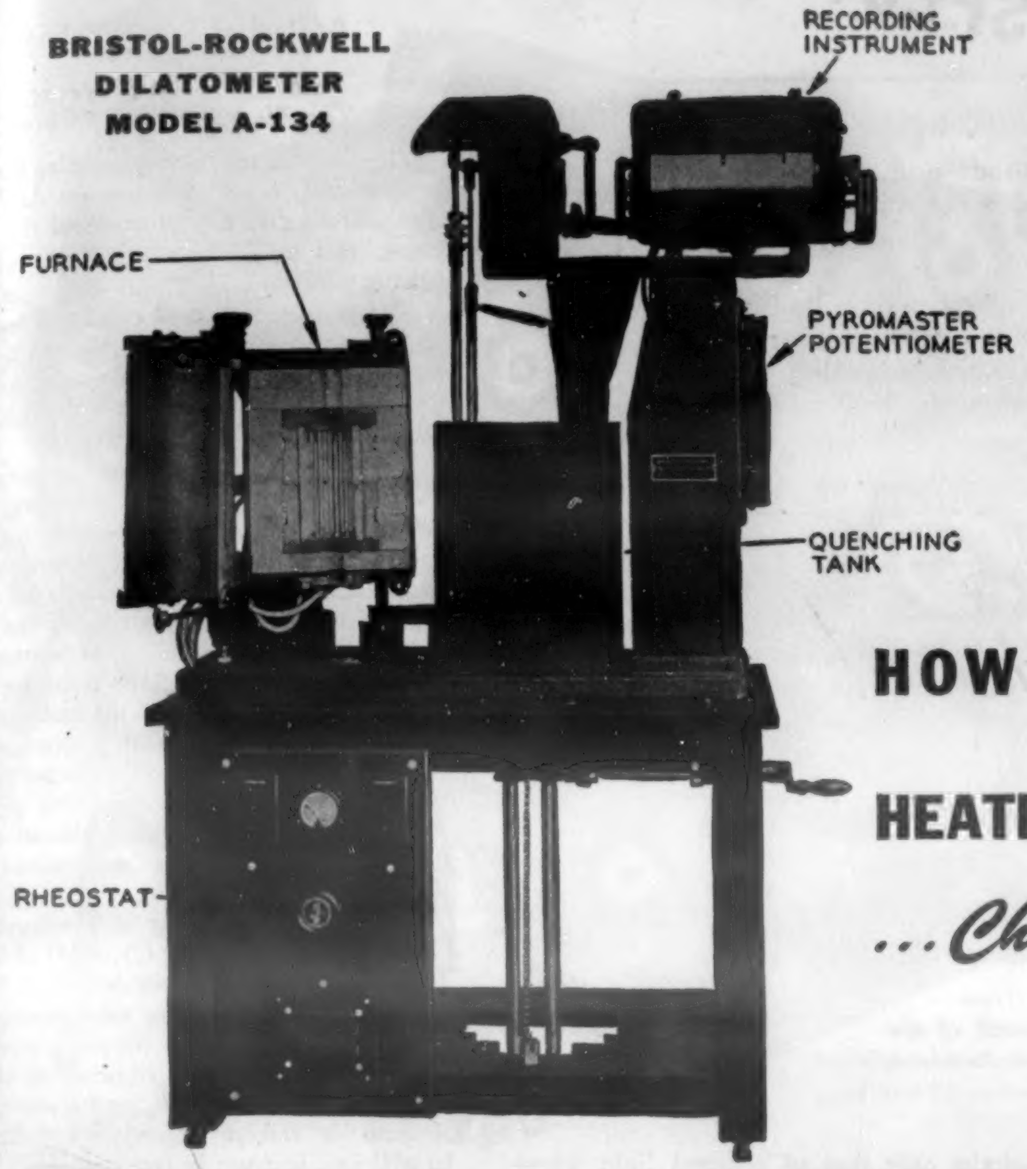

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Comparison of Machined Surfaces

Condensed from "Journal of Research of the National Bureau of Standards"

Recently the National Bureau of Standards was asked by the War Department to suggest a rapid and simple production-inspection method for comparing the roughness of somewhat similar machine-finished surfaces. The method was needed for identifying the rougher surfaces in the range, 100 to 500 microinches rms., that could not be rendered smooth by the application of single sprayed films of paint.

As shininess is one indication of surface smoothness, a photoelectric glossmeter was developed and tried for the purpose. Because the roughness involved is about one thousand times as large as that which may affect the gloss of surfaces, every test surface has to be coated before gloss measurement with a liquid that will fill its microscopic cracks and pores. A mixture of one part light mineral oil to nine parts methyl-chloride was found to give best results.

In choosing the parts for the glossmeter, a barrier-layer photocell was selected because of the simplicity of the electrical equipment required with it. A standard five-cell flashlight lamp, which possesses a small concentrated filament, was chosen for the light source. A ⅝-in. lens having a focal length of 4 cm. was selected because it gave a narrow beam of high flux density.

In the glossmeter the converging beam from the lens is directed, at an angle of 75 deg., onto a machined surface at right angles to the tool marks. The light specularly reflected by the surface proceeds toward the photocell chamber. The small window at the entrance to this chamber admits only rays of reflected light whose average deviation from the direction of mirror reflection does not exceed 6.5 deg. The interior of the chamber is coated white to conserve the light that enters.

The control case that accompanies the glossmeter contains a pointer-type galvanometer for registering photocell current, a 10-ohm rheostat for controlling the lamp current, a switch, and a small 110-6 volt transformer.

Liquid-coated steel surfaces of the type being studied were found to reflect from 2 to 25% of the incident beam into the photocell chamber. In using the glossmeter, an operator first places it on a clean, polished black-glass standard and adjusts the rheostat till the galvanometer registers a 26-division deflection. When this adjustment is made, the values of specular gloss are read directly as deflections of the galvanometer.

Although this instrument actually evaluates that fraction of surface area nearly parallel to mean surface not shaded by peaks, the instrument gives rapid and resonably reliable comparisons of the roughness of different surfaces prepared with about the same tool feeds. Because the glossmeter readings depend on the profile shapes rather than profile dimensions, the glossmeter is not a suitable instrument for roughness comparisons where tool feeds differ appreciably from specimen to specimen. (Richard S. Hunter. *J. Research, National Bur. Standards*, Vol. 36, Apr. 1946, pp. 385-391.)

Control of Brass Plating

Condensed from a Paper of The Electrochemical Society

The fact that satisfactory bonding between rubber and brass depends on both the composition and the structure of the latter necessitates a rigid control of the electroplating process.

The plating bath used consists of copper, zinc and sodium cyanide to which such substances as sodium hydroxide, sodium bicarbonate and ammonium hydroxide have been added to adjust the pH.

Rapid and accurate means are given for checking the copper and zinc with the polarograph and the comparable methods and results as determined by electrochemical and volumetric means. Analysis of brass deposits can be made by stripping the brass in an ammoniacal solution of ammonium persulfate and analyzing the resulting solution. From a knowledge of the bath volume, the composition of the plating solution, and numerical values for all of the other factors which may be controlled in this process, the necessary additions and alterations in the working conditions may readily be made.

In a solution working at a temperature of 75 to 90 F (24 to 32 C), a pH of 9.5 to 10.6 and a cathode current density of 6 to 8 amp./sq.ft. the following adjustments will result in increasing the copper content of the brass deposits: (a) addition of copper cyanide; (b) increase in temperature; (c) increase in current density; (d) decrease in pH; (e) increase in free cyanide.

Under the same set of conditions as indicated above, the percentage of zinc in the deposit can be increased by adding zinc cyanide, by lowering the temperature, decreasing the free cyanide, or the current density, or by increasing the pH. A small addition of ammonia is a most effective, though only temporary, measure for insufficient deposition of zinc.

An important characteristic of brass plating baths is their good throwing power, *i.e.*, their capacity to deposit plate of constant composition into the recesses of the work. This will vary with the composition of the alloy being deposited but, aside from this, it is a function of cathode polarization, current density, and free cyanide, and can be improved by adjusting any of these variables or by increasing the distance between anode and cathode.

The pH of a solution which plates 70/30 or 75/25 brass may vary between 9.4 and 11.0 (measured electrometrically) according to bath composition. For a given bath, the pH should be constant from day to day within 0.1 to 0.2 unit. Provided the electrode efficiencies are reasonably balanced and not too high, and that the solution is not allowed to become depleted in metallic cyanides, the pH will remain stable for long periods of operation.

The sodium carbonate content of the solution builds up gradually and should not exceed 60 to 70 g./l.; in a well-controlled electrolyte, this concentration may be maintained by drag-out effect. (H. E.

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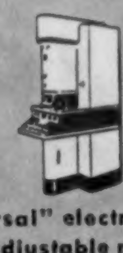

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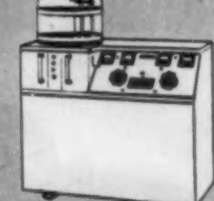

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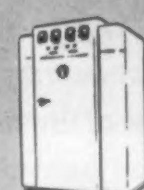
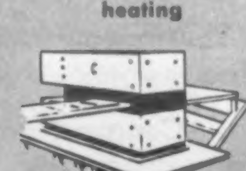
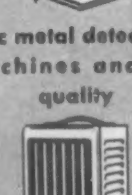


Electronic power generators for dielectric and induction heating



Electronic metal detector to protect machines and product quality



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Zentler, Gordon & Eric R. Roberts. *Electrochemical Soc.*, Reprint No. 90-2, Oct. 21, 1945, 14 pp.)

Microhardness of Small Parts

Condensed from "Wire and Wire Products"

The Tukon hardness tester, manufactured by the Wilson Mechanical Instrument Co., utilizing the Knoop indenter, has proved to be an invaluable tool for testing fine wire, metal and nonmetallic parts that are too thin to be tested with the standard Rockwell or Rockwell Superficial hardness testers.

Extremely shallow hardness indentations are made possible with the Knoop indenter, first described by Knoop, Peters and Emerson. The indenter is a pyramidal diamond cut to an included angle of 130 deg. in one direction and an angle of 172 deg. 30 min. perpendicular to the plane of the first angle. It is applied to a polished metal surface with a load of 25 to 3600 g., depending upon the relative hardness and thickness of the material being tested.

The load is automatically applied by push button control for 20 sec., which has been determined to be the minimum time required to give consistent results. The resulting indentation has an elongated diamond shape which permits extreme sensitivity of measurement. The long diagonal measures approximately seven times the width and 30 times the depth of the indentation.

The specimen to be hardness tested is usually mounted in a melamine thermosetting plastic and polished on fine emery papers and a fine abrasive lap. After polishing, the surface should be flat and free from deep scratches.

Hardness indentations are made with the Tukon tester on the polished surface, and the long diagonal is measured with a filar micrometer microscope. The Knoop hardness number may then be determined by converting the micrometer reading to millimeters and referring to a table supplied by the Wilson Mechanical Instrument Co.

The table is computed for a theoretically perfect indenter and cannot be used when extreme precision is required. When maximum accuracy is required, a formula is used which takes into account the correction factor supplied by the Bureau of Standards for each Knoop indenter.

It has been indicated in the foregoing paragraphs that the Tukon tester is an extremely versatile instrument, capable of testing many materials, both metallic and nonmetallic. Its range actually extends from the hardest materials, diamonds, through the sofest metals and minerals. Furthermore, the hardness of all these materials may be proportionally recorded on one scale, giving Knoop numbers of 8000 for diamond down to 32 for gypsum.

Numerous uses have been found for the Tukon tester at many companies in both research and production testing. The ability to test the hardness of very small areas and of a wide range of materials makes the Tukon tester one of the most important instruments developed for material control during recent years. (G. E. Shubrooks. *Wire & Wire Products*, Vol. 21, July 1946, pp. 515-518, 548.)

The Industrial THERMAX in its Tenth Anniversary Model

IN 1936, ten years ago, Machlett introduced the Thermax—the first shockproof X-ray tube to combine in one unit radiographic, superficial and intermediate therapy applications. During the years since, it has made an outstanding contribution in these fields, giving the user a broadened field of techniques with minimum investment. The demand for tubes of this type or units of similar design offering even greater capacity, has been beyond our early expectations. As a result of this extensive experience, much additional knowledge was gained, which has enabled Machlett to completely redesign the tube. All the newest improvements have been incorporated without changing the external dimensions, and thus the tube can be used as a replacement in your present equipment.

The same small-sized housing is retained, rotatable through 360°. Strength has been increased at vital points. The new features increase the ruggedness and improve the function of the mechanical and electric internal structures.

COOLING: Heat dissipation is substantially increased: Two models: water-cooled and oil-cooled. Latter now features a new system of supplying the oil in a highly efficient jet discharge. Metal in cooling system is corrosion-proof super-nickel.

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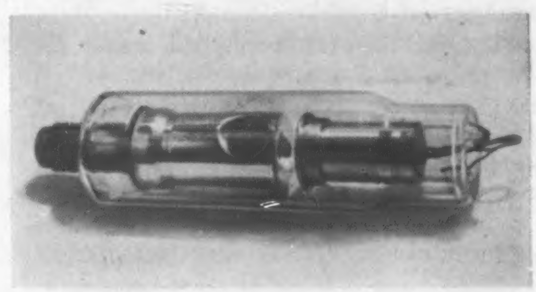
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BOOK REVIEWS

Organic Finishes

MODERN ORGANIC FINISHES. *By R. H. Wampler. Published by Chemical Publishing Co., Inc., Brooklyn, N. Y., 1946. Cloth, 5¾ x 8¾ in., 452 pages. Price $8.50.*

This book fills a need in modern industrial finishing operations. It describes modern finishing materials and equipment for their application, drying and conveying. The author's aim is to acquaint the manufacturers with coatings and finishing application equipment now available, and to describe efficient practices and typical procedures for finishing manufactured articles.

It is agreed that the sales appeal of manufactured products, automobiles, houses, baby carriages, pianos, refrigerators, washing machines, furniture items, rubber shoes, etc., depend to a very large measure to their appearances, and that aside from design, the chief factor in eye-appeal is surface color and texture. Protective and decorative organic coatings, products of the paint industry, are mainly responsible for imparting rich, colorful, and smooth or textured surfaces (finishes) on items manufactured by almost all industries; but, if the coatings are not properly applied to the various surfaces, the life of the resulting finishes will be disastrously short. In many instances the engineering efficiency of the coated products will be seriously affected. Mr. Wampler rightly points out that "In many cases, the manufacturer knows less about the finishing operation than about any other production operation," and, "that the selection of coating materials and equipment is based too frequently on inadequate knowledge of the finishing problems."

This reviewer can point out many instances where the application of organic coating did not receive any consideration until the manufactured products were well along in the production line.

The contents of this book should aid those interested to intelligently select coatings and applications methods most adaptable to specific needs and obtain the best possible finish at lowest cost.

This book is well illustrated and is divided into six main appropriate sections: 1, Modern Organic Finishing Materials; 2, Modern Application Methods; 3, Drying Methods; 4, Product Handling in the Finishing Department; 5, Finishing Processes; and 6, Some General Considerations.

It is further sub-divided into twenty-five chapters: Oleoresinous and Alkyd Varnishes and Enamels; Cellulose Lacquers; Stains, Wood and Metal Fillers; Spray Painting; Dipping and Flocoating; Roller and Knife Coating; Tumble and Centrifugal Finishing, Special Processes; Air Drying, Force Drying; Baking by Convection and Radiant Heat; High-Frequency Baking; Conveying Methods; Wood Furniture and Cabinets; Prefinishing Wood, Plywood and Hardboard Structural Materials; Special Industrial Wood Finishing; Paper, Cardboard and Fabrics; Plastics and Resin-Impregnated Wood; Cleaning and Surface-Treating Metals; Automotive and Railway Equipment; Steel Sheet Products; Iron Castings; Aircraft; Rubbing and Polishing Organic Finishes; Good Practice in the Finishing Department; Testing and Evaluating Finishes.

Designing engineers and technicians today appreciate the value of organic coatings as engineering materials, and thus are giving more consideration to the problems dealing with the selection and proper application of organic coatings. This book will be very valuable to those manufacturers having finishing departments, its superintendents or production executives and purchasing agents, and the technical members and executives of the paint industry.

—J. J. MATTIELLO

American Minerals

MINERALS YEARBOOK, 1944. *Published by Bureau of Mines, and for sale by Supt. of Documents, U. S. Govt. Printing Office, Washington 25, D. C., 1946. Cloth, 6½ x 9½ in., 1636 pages. Price $3.00.*

Publication of foreign trade data and data on many strategic and critical minerals, first interrupted in the 1941 volume, was reestablished for most commodities on V-E day, with all remaining censorship regulations removed on V-J day. The 1943 volume, issued in June 1945, was the first one under the new conditions (this was reviewed in METALS AND ALLOYS, Sept. 1945, page 866).

The 1944 volume is described as departing from the 1943 edition in but one main respect—the chapter on International Aspects of War Mineral Procurement has been greatly expanded so as to include a section on Foreign Minerals Review, with particular emphasis on Latin-American countries. This new section is labeled Part V of the volume and is announced as a permanent feature of future editions.

The 1944 edition maintains the high standard of previous issues and is of pronounced value to those interested in the fields covered.

Gases in Light Metals

GAS IN LIGHT ALLOYS. *By L. W. Eastwood. Published by John Wiley & Sons, Inc., New York, 1946. Cloth, 5½ x 8½ in., 99 pages. Price $2.50.*

Dr. L. W. Eastwood has succeeded in filling a long felt need in the light metal field by writing a comprehensive treatise on the problem of gas in light alloys in this book.

Written in easily understandable language, it enumerates in condensed form the principal sources of gas absorption, the factors of solution and diffusion, the general effect of gas porosity on the metal, and all other known factors. It is pointed out that hydrogen is the only gas which really causes the foundrymen trouble. Methods for the determination of the gas content are given. It is shown that even by relatively simple means one can at least qualitatively determine the gas content.

The ways and means shown to avoid gas absorption, and the methods of degassing given, teach mainly that by proper and careful foundry technique one does not necessarily have to be troubled with gas in light alloys. It is only necessary to understand the characteristics of the few types of aluminum alloys (magnesium alloys), and one can practically eliminate most of these difficulties by proper preventive measures or by the application of degassing methods.

An attempt has been made to clarify the nomenclature and to make a distinction between gas and shrinkage porosity. The book is well illustrated, sustaining very well the statements made in the text. An extensive bibliography gives the more curious reader a chance to wade through great masses of words on the subject.

The book should be studied by every foundryman. It is so condensed and to the point that this is really an easy task.

—W. BONSACK

Other New Books

EXPERIMENTAL STRESS ANALYSIS, VOL. III, No. 2. *Edited by C. Lipson & W. M. Murray. Published by Addison-Wesley Press, Inc., Cambridge, Mass., 1946. Cloth, 8½ x 11¼ in., 166 pages. Price $5.00.* This is another volume in a series of the Proceedings of the Society for Experimental Stress Analysis, Cambridge, Mass. It contains 11 discussions or papers by various authors. Some of the topics include "Improvements in Rosette Computer," "Stress Distribution in Spur Gear Teeth," "Use of Electric Resistivity Strain Gages over Long Periods of Time," "A Review of Some Mechanical Failures of Steel Plant Machine Equipment," "Allowable Working Stresses," "Photogrid Strain Analysis of Formed Parts," etc.

INVOLUTOMETRY AND TRIGONOMETRY. *Computed and compiled by W. F. Vogel. Published by Michigan Tool Co., Detroit, Mich., 1945. Fabrikoid, 8 x 11 in., 321 pages. Price $20.00.* New material of practical value to the gear engineer is presented for the first time in this volume. There is included a rationalization of the new science of involutometry and its relation to other branches of mathematics. The book contains a main table of about 180 pages and three appendices, the main table being a complete table for trigonometry as well as for involutometry. The numerical tables are intended to simplify engineering calculations relating to the design and manufacture of products based on involute curves and surfaces—such as gears, gear tools, splines, etc. The book classifies the various curves and surfaces, describes their geometrical properties, and gives the basic calculations related to them. Particular attention is called to a gear appendix, of value to the gear engineer.

New Materials and Equipment

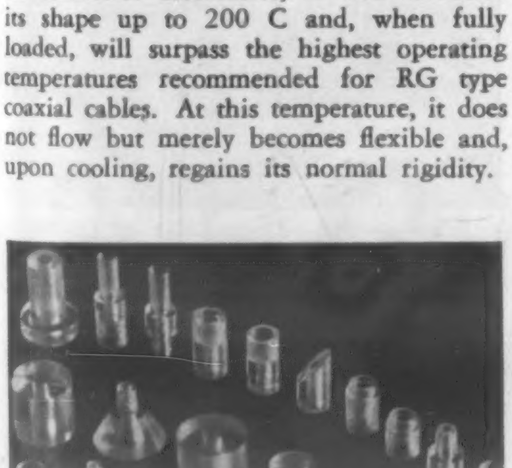
Plastic Developed for High Frequency Equipment

A new plastic material having characteristics suitable for parts in television, frequency modulation radio and radar sets as well as other ultra-high frequency insulating applications has been announced by the *Plastics Divisions* of the *General Electric Co.,* Pittsfield, Mass.

Known as Textolite No. 1422, the new material possesses a low power factor with an ASTM heat distortion of 105 to 113 C. It machines readily enough to be adaptable to automatic and semi-automatic fabricating equipment.

The new plastic can be used where compression and injection molded plastics are not sufficiently suitable because of the close tolerances or where they do not possess the necessary combination of heat resistance and electrical properties.

Tests of the new material indicate that, under the light loads commonly encountered in connector assemblies, it will maintain its shape up to 200 C and, when fully loaded, will surpass the highest operating temperatures recommended for RG type coaxial cables. At this temperature, it does not flow but merely becomes flexible and, upon cooling, regains its normal rigidity.



Display of a variety of parts made of Textolite No. 1422

The plastic has a dielectric constant at 3000 MC of 2.4 to 2.5 and a power factor at 3000 MC of 0.0006 to 0.0009. It has a specific gravity of 1.045 to 1.050, tensile strength (ASTM-D638-42T) of 15,000 to 18,000 psi., compressive strength (ASTM-D649-42T) of 18,500 to 19,000 psi., impact strength (ASTM-D256-43T) of 0.25 to 0.35, and a Rockwell hardness H-scale of 68 to 72.

The material is unaffected by mineral acids, alkalies, alcohols, aliphatic hydrocarbons or mineral oil. Aromatic hydrocarbons cause swelling, while chlorinated hydrocarbons and ketones cause slight swelling. Water absorption (ASTM-D570-42) is less than 0.05.

Instrument Checks Composition and Condition of Ferromagnetic Materials

A device, known as the Ferrograph, has been developed by *Allen B. Du Mont Laboratories, Inc.,* Passaic, N. J., to compare ferrous materials as to both their chemical analysis and heat treatment. This instrument, based on the correlation between magnetic properties, particularly residual magnetism which predominates at the low frequency that is used, and metallurgical properties, makes possible the determination of composition and condition of ferro-magnetic materials by magnetic testing, with the cathode-ray tube as the indicator.

The basic principle of operation of the Ferrograph is the harmonic analysis of the induced voltage in the secondary of a test transformer in which the sample to be tested is made the core. It uses an energizing field of a frequency below 25 cps., with the reversals of the magnetic field slow enough so that an appreciable effect is obtained from the remanent magnetism. Also, the use of the cathode-ray indicator means high sensitivity with portability; the complete waveforms can be seen and so need not be estimated; phase angles can be measured and compared by relatively unskilled personnel.

The practical uses of the Ferrograph are best illustrated by these typical examples:

Steel bars were sorted to reject those softer than 32 Rockwell C. Readings of first and third harmonic amplitudes did not provide a practical separation. However, observation of the relative phases provided a sufficiently sensitive test for correlation with hardness, so that the separation could be made.

Steel bolts ½-in. in dia. and 3-in. long were accidentally made of two different steels. The error was not discovered until after the bolts had been heat treated. The bolts made of SAE 1035 were satisfactory, but those made of lower carbon SAE 1020 were too soft. The hardness of the two lots differed by 15 points Rockwell C.

A few samples of bolts made of each steel were identified in a hardness machine, and their respective patterns established on the cathode-ray tube screen, establishing the fact that there was no overlapping of the indications for bolts made from the two steels at the flux density chosen. Sorting proceeded on the mixed bolts at a rate of about one per sec.

● The *White & Bagley Co.,* Worcester, Mass., announces a new liquid type water-soluble lubricant. It is named Economy Lubricant #1888. This new lubricant may be used for both grinding and cutting. In metal-working operations such as milling, drilling, turning, gear cutting, etc., it is said to give longer tool life, cleaner chip removal, and better surface.

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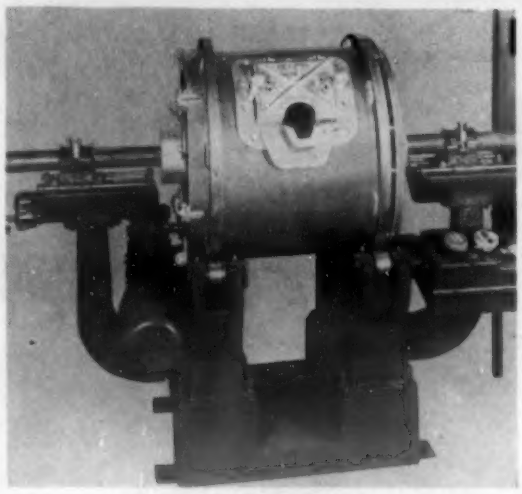
Developments Made in Heating Equipment to Meet New Requirements

New furnaces, ovens, and induction heating equipment are constantly being developed to meet the varied and changing needs of the metal producing and metal-working field. Here are some of the latest which have come to our attention:

Indirect Arc Rocking Electric Furnace

The *Detroit Rocking Electric Furnace Div.* of *Kuhlman Electric Co.,* Bay City,



This indirect arc rocking furnace is designed for melting a variety of ferrous and non-ferrous alloys.

Mich., has developed a new type indirect arc rocking electric furnace which is designed especially for easy change of shells to permit melting of a wide variety of ferrous and nonferrous alloys.

Designated Type LF, and rated at 100 kw. with 200-lb. nominal cold charge capacity, the furnace features nonrotating graphite electrodes supported by stationary brackets. Flexible copper conductors bring power to the water-cooled electrode clamps from bus bar situated above or below the furnace. By withdrawing the electrodes the melting chamber can be removed without having to detach the electrode brackets. In a typical 9-hour-day's operation, this furnace has melted seventeen 225-lb. heats of red brass per 9-hour-day—3825 lb. total—with a total overall energy consumption of only 318 kwh. per ton.

Small Parts Electric Furnace

The *Thermo Electric Mfg. Co.* of Dubuque, Iowa, has a new electric furnace, known as the Model CEA, for general laboratory use and for production heat treating of small parts.

The heating chamber measures 4¾ in. wide, 4¼ in. high and 6 in. deep, with overall dimensions of 12 in. wide, 15½ in. high and 14½ in. deep. The furnace will maintain a temperature of 2000 F continuously, and automatically holds any selected temperature from 500 F to 2000 F; it will heat up to 1500 F in 30 min.

Construction of the new furnace includes one-piece aluminum castings for the body and door. The counter-balanced door is hinged to swing forward to provide a loading platform. Insulation is cast permanently in place inside the furnace body. Special high temperature alloys are used for the heating element which completely surrounds the chamber. This heating element is safely protected against damage or chemical deterioration. A variable heat control is provided. An indicating pyrometer shows muffle temperature, and is calibrated in both Fahrenheit and Centrigrade scales.

Gas Carburizing Furnaces

The *Industrial Heating Div.* of the *General Electric Co.,* Schenectady, N. Y., is producing a new line of electrically heated, cylindrical, gas carburizing furnaces with maximum temperatures of 1800 F. The new furnaces have a fan located on the furnace cover; they are suitable for carburizing such parts as gears, splines, pins, and bearing races.

There are three furnaces in the new line, rated at 59.5 kw., 77.5 kw. and 110 kw. Loading baskets in the three sizes are 20-in. dia. by 24-in. deep, 20-in. by 36-in., and 25-in. by 36-in., respectively. The furnace cover is lifted hydraulically, and guides are provided which prevent it from being lowered unless it is in proper position for sealing with the retort in the furnace. A 1½-hp. fan is used on all three sizes.

Tanked propane or natural gas is admitted to the furnace retort as the carburizing medium. The flow of gas is regulated by a needle valve and a visual flow meter, which are mounted on the operator's control panel. Also located on the panel are an automatic temperature control instrument and a strip chart temperature recording instrument for recording the

These electrically heated gas carburizing furnaces have a maximum temperature of 1800 F.

temperature of the circulating atmosphere and charge of steel.

3-Chamber Heat Treating Furnace

Modifications of its 3-chamber heat-treating furnace are announced by the *Barkling Fuel Engineering Co.,* Chicago 22.

The base of this pedestal-type furnace is now made of welded steel for lighter weight without loss of strength. A shelf is provided for holding tools, or parts waiting to

e processed. Tripping hazard of jutting lower has been eliminated by vertical reamlined mounting.

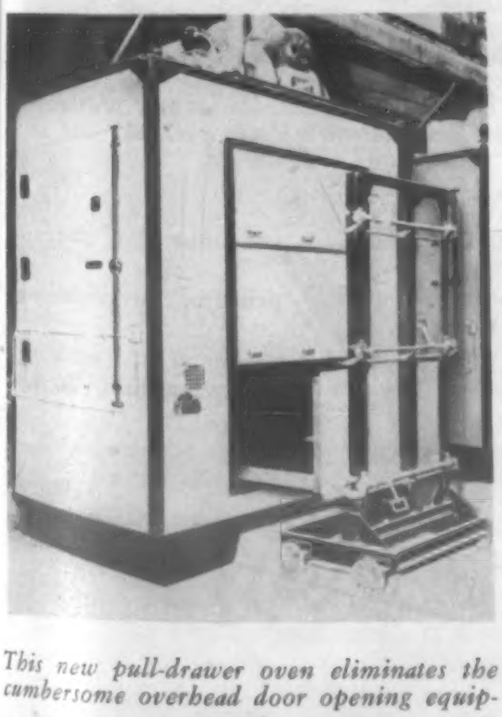
The lower fire box now develops 2500 F n 15 min., and the center fire box 1800 F n 14 min. A low heat of 600 F can be tained and held in the center chamber. hot-plate roof is provided for tempering.

Modifications on this 3-chamber heat treating furnace made chiefly for added convenience.

Pull-Drawer Oven

The *Gehnrich Oven Div., W. S. Rockwell Co.,* Fairfield, Conn., offers a new type of pull-drawer oven. The oven is designed with the drawers supported on a puller mechanism set on a simple channel iron base frame riding on ball bearing wheels in a track guide on the plant floor. The puller engages any one or all the drawers, and can be pulled or pushed by one man. When all drawers are inside the oven, the puller base projects 15 in. in front of the bottom of the oven.

The oven itself can be heated by electric heaters nested at one side and baffled from the heating chamber. Where gas, oil or steam heating is desired, an air heater can be installed on the oven roof, or gas or oil burners can fire into a combustion chamber at one side of the oven. Heat is drawn from the heater (or combustion chamber) through a recirculating fan on the roof, discharging into a slotted supply duct at the other side wall and blowing horizontally across the work, returning through the heater. An exhaust fan on the roof is supplied where required, for purging the oven of undesirable vapors.



This new pull-drawer oven eliminates the cumbersome overhead door opening equipment.

This type of oven is satisfactory for core baking, mold drying, low temperature drawing and heat treating of metal products, baking finishes on products, curing and treating plastics, drying chemicals, and many other applications.

Combination Induction and Dielectric Heater

The *Induction Heating Corp.,* 389 Lafayette St., New York 3, has announced the development of an electronic heating generator suitable for both induction (metal) and dielectric (nonmetal) heating operations. It is designed for use in experimental laboratories, testing depots and development research departments.

This heating generator is provided with two separate, interchangeable oscillator sections, one for induction and the other for dielectric heating. Changeover from one oscillator section to the other is accomplished by removing one oscillator section and replacing it with the other. The induction oscillator feeds into a radio-frequency output transformer, while the dielectric oscillator feeds through coaxial cables to heating electrodes.

The unit is a high-frequency generator, operating on 205 to 245 v., 60-cycle, single-phase power supply, and having a full-load input of 12 kva., at 90% power factor. Its full-load output is 285 Btu. per min., or approximately 5 kw. at nominal frequencies of 375,000 cycles per sec. for induction heating and 20,000,000 cycles per sec. for dielectric heating operation. The tube complement of this unit comprises two mercury-vapor rectifiers and one water-cooled oscillator.

The unit is suitable, when operating as an induction heating unit, for thin case-hardening, heat treating, through hardening for metallurgical processing, brazing, forging, melting and soft soldering.

When operating as a dielectric heating unit, it heats nonconducting materials. Textile processing, wood gluing and laminating, dehydration of foods, preheating and polymerizing of plastics, rubber curing, and foundry core baking are typical applications of the unit.

Continuous Induction Heater for Steel Slugs

The *Ajax Electrothermic Corp.,* Trenton 5, N. J., has designed an induction heater for continuous automatic heating of steel slugs or forging blanks prior to forging operations. This new induction heater ejects a heated slug at the desired temperature, every few seconds.

The cold slugs are loaded into a roller type chute on the left side of the heater, are fed continuously through the horizontal heating coil by a pneumatic ram, and drop

(Continued on page 1292)

METALLURGICAL BOOKS

The Heating of Steel
By M. H. Mawhinney, Consulting Engineer, Salem, Ohio. This volume is an indispensable reference work for plant engineers, production men, metallurgists, fuel technologists and students in the metal-working and furnace-building industries. A few of the subjects covered are: Atmospheric control in open furnaces, Heat transfer and fuel economy, Automatic stokers, Pyrometry and instrumentation of furnaces, Refractories and construction of furnaces, Heat-treating of finished steel, Temperature distribution in furnaces, Quenching of steel, Burner equipment, Decarburization, Continuous billet furnaces, Annealing furnaces. A further indication of the importance of the subject matter is given in the list of 33 tables of highly important engineering data. 265 pages, 220 illustrations, 33 tables. **$5.00**

The Metallurgy of Quality Steels
By Charles M. Parker. The book is of primary interest to engineers, plant men and student metallurgists who expect to have much to do with using, handling or making modern steels and who want either a clear and simple introduction to or a quick review of their metallurgy. 250 pages, illustrated, 1946. **$6.00**

Beryllium, Its Production and Applications
By Zentralstelle fur Wissenschaftlich-Technische Forschungsarbeiten des Siemens-Konzerns. Translated by Richard Rimbach and A. J. Michel 24 articles, each by a leading specialist, deal with metallography and the physical properties of Beryllium and its alloys. Their remarkable characteristics are dealt with in detail and the subject of age hardening is completely discussed. 331 pages. **$10.00**

A Course in Powder Metallurgy
By Walter J. Baeza. Describes the essentials of successful uniform production of powder metallurgy parts, with details of 15 experiments, and graphs showing the relationships between processes involved and all the properties of the finished products. 212 pages. **$3.50**

Metals and Alloys Data Book
By Samuel L. Hoyt. The most complete, practical, informative book of its kind ever published. Contains 340 tables of critically evaluated data on wrought and cast iron, stainless steels, alloys and rare metals, and gives all their important properties. 350 pages. **$5.50**

Infrared Spectroscopy Industrial Applications
By R. Bowling Barnes, Robert C. Gore, Urner Liddel, and V. Z. Williams. An informative, authoritative work in a field of increasing interest, presenting exhaustive data on the determination of physical properties from fundamental spectroscopic measurements, with extensive bibliography. Exceedingly valuable for metallurgists, physicists, chemists, and particularly for those engaged in experimental work in synthetic rubber and petroleum derivatives. 236 pages. **$2.50**

Silver in Industry
Edited by Lawrence Addicks. This symposium on silver contains the work of thirty contributors, each of whom is a specialist in the field on which he writes. The volume is in truth an encyclopedia of information on this metal and its alloys. The value of this work is further enhanced by a tremendous bibliography, containing over four thousand literature references and a list of all the patents issued on the industrial uses of silver. 636 pages. **$11.00**

Corrosion Resistance of Metals and Alloys
By Robert J. McKay and Robert Worthington. A concise outline of the theory of corrosion is given in this book as well as data from test and experience on modern corrosion problems. This book fills in the gap between modern works on the corrosion of individual metals on the one hand and on specific theories of corrosion on the other, and summarizes the vital points of each treatise. A. C. S. Monograph No. 71. 492 pages. **$7.50**

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out at the other end of the coil into a chute or tongs, ready to be placed in the forging dies.

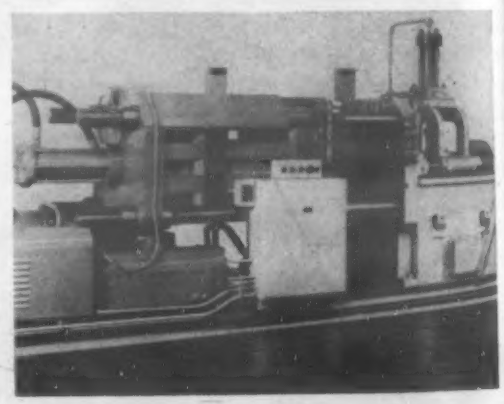
Production rate with slugs 3⅜-in. dia. by 1¾-in. long, heated to about 2200 F, for instance, is 350 per hr. Power source is a 200-kw. motor-generator set, operating at about 1000 cycles per sec.

The heater can be converted from one job to another by changing the heating coil proper, resetting the timing device, and adjusting the feeding chute.

Die Casting Machine Designed for Zinc, Aluminum and Brass Alloys

A pressure die casting machine for zinc, aluminum and brass alloys has been announced by *Hydraulic Machinery, Inc., Die Casting Machinery Div.,* 12825 Ford Rd., Dearborn, Mich. It is identified as Model M-114. The machine is fully hydraulic and self contained. The equipment includes the following: heating unit for metal, electric motor, valves for water lines, oil pump unit, filters or strainers in lines where necessary, and shut-off valves at important places in oil and water lines.

A "deoxidizer," which is standard equipment on zinc alloy machines, is said to reduce dross to a minimum. A complete unit (with the cold chamber arrangement into which the metal is ladled) is available for high pressure die casting of aluminum and brass alloys. The die casting machine is so constructed that the "hot," or furnace, end can be interchanged quickly for either



This die casting machine for zinc, aluminum and brass alloys is fully hydraulic and self contained.

zinc or aluminum and brass alloy production.

Some of the principal specifications follow:

Size of die plates—center to center of bars 24 by 24 in.; between bars, 20 by 20 in.

Die opening—10 in.

Die space—maximum 28 in.; minimum 12 in.

Pressure per sq. in. on metal—zinc, 6,000 lb.; aluminum and brass, 16,000 lb.

Locking pressure—400 tons.

Floor space—54 by 180 in.

Approximate weight—16,000 lb.

Capacity of melting pot—zinc and brass, 500 lb.; aluminum, 200 lb.

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PRECIOUS METALS SINCE 1875

Forging Process for High-Alloy Tool Steels Reduces Residual Strains

Additional details in a new process for forging high-alloy large diameter steel rounds have been announced by the *Barium Steel & Forge, Inc.*, Canton, Ohio. The process was developed with the metallurgical assistance of *Jessop Steel Co.*, Washington, Pa.

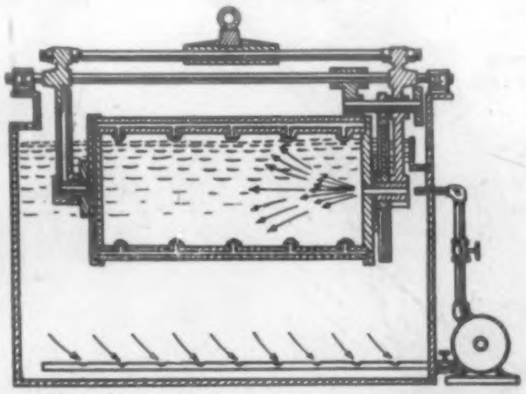
With this new forging practice for tool steels, it is possible to forge successfully rounds up to 12-in. dia. with a reduction of residual strains, elimination of center bursts, and assurance of uniform cross sectional carbide distribution.

The forging practice involves use of a V-type bottom die and a flat top die in a hydraulic press. Starting with a square billet, the corners are progressively laid down until a round shape is obtained. The kneading action refines the structure to a degree not heretofore possible with conventional hot working methods.

Plating Barrel Features Pumping Equipment As an Integral Part

The *Hanson-Van Winkle-Munning Co.*, Matawan, N. J., has developed plating apparatus with pumping equipment. Their tests showed that where the plating apparatus is furnished with pumping equipment, the plating time is reduced. For example, on one such unit where cadmium plating is being done, the plating time has been cut from 20 to 25%. In working with cyanide solutions, the amount of cyanide consumed is cut down and the carbonates in the bottom of the tank are reduced in volume. The solution is agitated by the pump and a finer grade of plated work is obtained.

Where cyanide solutions are involved an iron pump is used; in acid solutions, such as nickel, a Duriron pump is specified.



Schematic layout of plating barrel, tank and pumping equipment.

The pump capacity is from 25 to 100 gal. per min., depending upon the size of the installation.

When the pumping unit is in operation, the solution is drawn off from the tank through a perforated pipe near the bottom and is pumped back into the tank through a pipe running the full length of the unit, situated directly under the overflow, which allows the solution to be pumped directly into the inside of the cylinder.

The company has also announced the

(Continued on page 1296)

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This automatic fountain marker's pride in its own performance and appearance is understandable. Made of Alcoa Aluminum, it is light in weight and tireless to work with. Dressed in a handsome, hard Alumilite* finish, there's no "wear out" to it.

Again you see an example of how manufacturers are employing Alcoa Aluminum to make finer, better looking products. Does it suggest new uses to you?

The best time to incorporate Alcoa Aluminum in your products is while they're in the design stage. Slight changes there often permit big savings in manufacturing costs. For help in including aluminum, get in touch with the nearby Alcoa office. Or write ALUMINUM COMPANY OF AMERICA, 2162 Gulf Building, Pittsburgh 19, Pennsylvania.

*Process patented by Aluminum Company of America

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Send for booklet "Ingot Metals of Today"

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NOTE: * "Proper Melting Decreases Foundry Losses," contains interesting data. Also, the booklet, "Non-ferrous Ingot Metals of Today." Write for both. They are free.

Successful foundrymen deoxidize or "clean up" molten metal by a scientific method worth using as indicated:

They use phosphorus . . . expertly . . . in the form of "Ajax Phosphor Copper" . . . added as the crucible is removed from the furnace . . . for virtually all brass and bronze alloys.

In notched waffle sections, or in shot form, Ajax 15% P-Cu does its work at .01% (1 oz. per 100 lbs.). Introduced, and having time to react when stirred with a whirling motion of the skimmer, it causes oxides to rise for effective removal by skimming from the surface. It is best to avoid phosphorus build-up from back stock.*

If you use phosphorus these days, use Ajax Phosphor Copper (useful also in producing your phosphor bronze).

SINCE 1880

AJAX METAL COMPANY — PHILADELPHIA 23, PA.

ASSOCIATE COMPANIES

AJAX ELECTRIC CO. • AJAX ELECTROTHERMIC CORP. • AJAX ELECTRIC FURNACE CO. • AJAX ENGINEERING CO.

JOHNSON *Wire*

SPECIAL ALLOY FINISH

Here is a major development—better coating than tin—no restrictions. This new smooth satin alloy finish resistant to corrosion and rust . . . acts as a lubricant . . . reducing tool wear . . . withstands 700° Fahrenheit . . . gives you the highest tensile without disrupting the physicals. Sizes .003" to .080".

New Johnson catalog containing a wealth of wire information yours for the asking.

JOHNSON STEEL & WIRE CO., INC.
WORCESTER 1, MASSACHUSETTS
NEW YORK AKRON DETROIT CHICAGO LOS ANGELES TORONTO

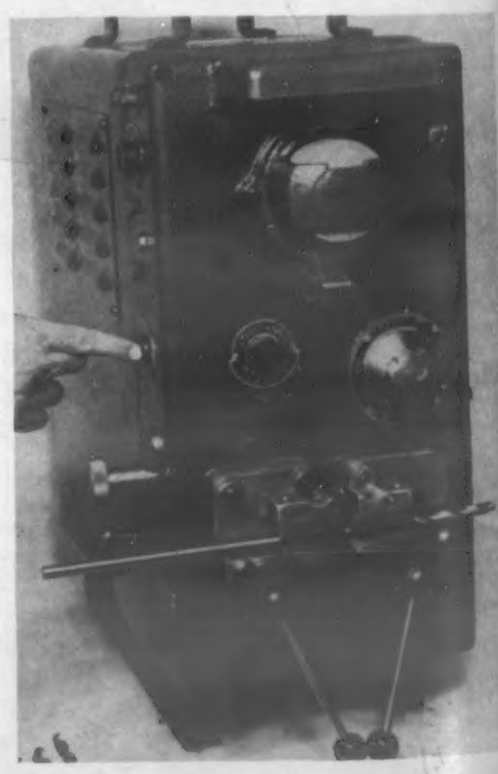
development of a new portable barrel unit, designed for small quantities of work. This unit can be furnished with a steel cylinder for cleaning, with a Monel cylinder for pickling, or with a rubber or Bakelite cylinder for plating. The cylinder for cleaning or pickling (made of steel or Monel) is 8 in. in dia. by 18 in. long.

The unit with the steel cylinder can also be used for tanks containing solution for black oxide finishes such as Jetal. The unit for plating (with rubber or Bakelite cylinder) has chain dangler contacts, and the cylinder can be 6 in. in dia. by 12 in. long or 8 in. in dia. by 18 in. long. The overall length of the portable unit with the 6 by 12-in. cylinder is approximately 20 in., height, approximately 16 in.; weight, in the neighborhood of 70 lb. A cylinder of this size will hold approximately 2 quarts of work.

Flash Butt Welder Repairs Small Tools

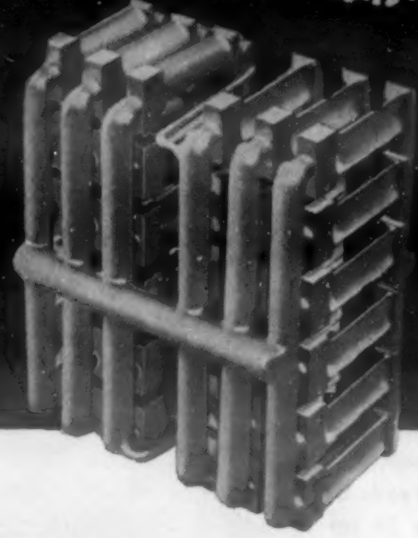
A new portable welder designed for production welding of bar and round stock up to 5/16-in. dia. is announced by the *DoAll Co.*, 1301 Washington Ave., South, Minneapolis 4, Minn. It can be used for repairing small tools, butt welding tool bit extensions and shanks, and joining band saw blades from 1/16 in. to 1¼ in. in width.

Characteristics of the welder include: built-in grinder for weld dressing, automatic motor controlled feed of material, and cam operated lever method of clamping. Welding is fully automatic, the cycle being controlled by one pushbutton switch. In addition to welding, annealing and flash dressing, an etching attachment provides a means of permanently identifying workmen's tools, templates, attachments, jigs, fixtures, dies.



The butt welder shown with a drill in position ready for welding.

A Message to — Precision Casting Processors



FURTHER ADVANCES IN THE CHEMISTRY OF *Pattern Waxes* PERMIT CASTING TO NEW CLOSE TOLERANCES

Whether you are injecting under low pressure or high pressure, we can supply waxes engineered to advanced formulae that will give "precision" a new meaning in your casting operations.

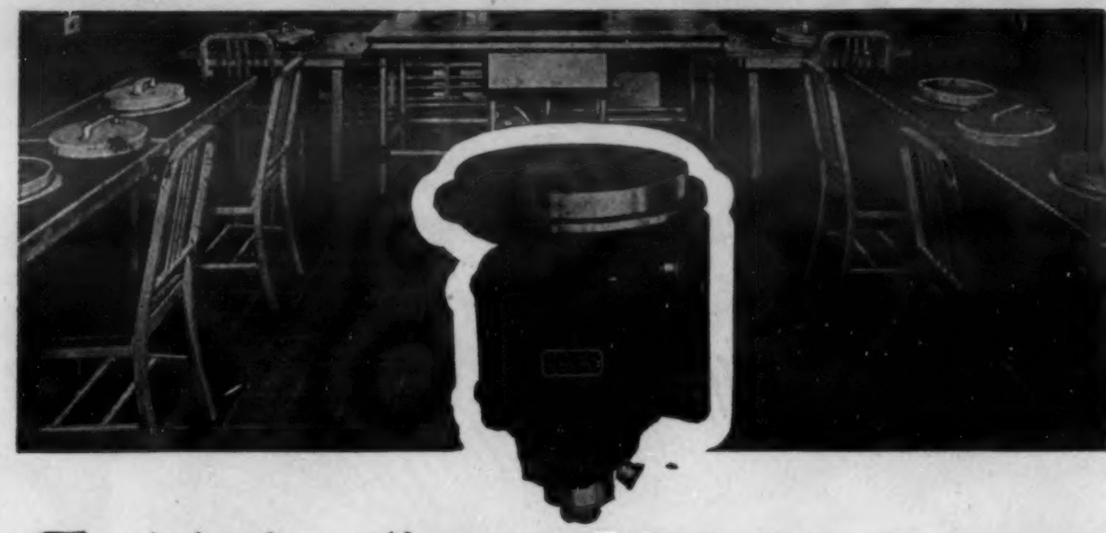
Since 1933 we have been leaders in the development of special wax formulae for both ferrous and non-ferrous metals. We offer waxes whose minimum shrinkage and short working cycles assure rapid and uniform production of sturdy, smooth-surfaced patterns, easy to remove from the mold. For example, it was Yates that pioneered the wax used in the precision casting of buckets for turbosuperchargers.

WORKING SAMPLES ON REQUEST

If you will tell us what pressure you are using, and make mention of any special performance characteristics desired in your pattern wax, we will be glad to supply you with working samples. There is no obligation, of course.

**Photograph courtesy of Austenal Laboratories, Inc.*

J. YATES DENTAL MANUFACTURING CO.
340 WEST HURON STREET CHICAGO 10, ILLINOIS



The Cincinnati METALLOGRAPHIC POLISHING MACHINE
produces SCRATCH-FREE SPECIMENS EVERY TIME!

Features

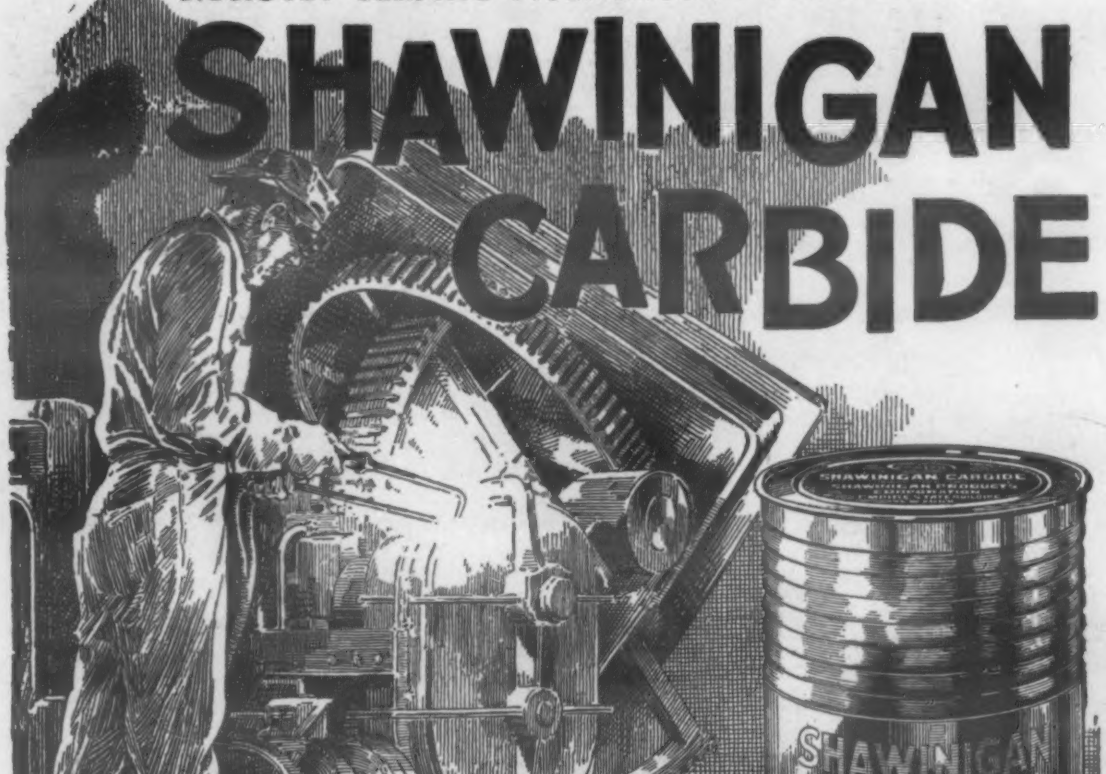
- No belts, no friction drive — direct-connected.
- No excessive noise or vibration.
- Bronze bowl, disk and ring resist corrosion.
- No splashing of polishing materials.
- Ball bearing throughout.
- Easy to clean.

The Cincinnati Variable Speed Polishing Machine sets a new standard of efficiency for smoothness and simplicity of operation in the preparation of specimens for microscopic examination . . . uniformity and scratch-free surfaces are achieved consistently — even with inexperienced operators — because of the smooth running, direct connected, variable speed motor which gives a range of speeds between 300 and 3,000 R.P.M. Write for Bulletin S9 for full descriptive details.

THE CINCINNATI ELECTRICAL TOOL CO.
2685 Madison Road Cincinnati 8, Ohio

Master Hands on Intricate Jobs use

SHAWINIGAN CARBIDE



SHAWINIGAN PRODUCTS CORPORATION
EMPIRE STATE BUILDING,
NEW YORK 1, N.Y.

Reverse Bending Fatigue Machine Tests Small-Metal Assemblies

A new instrument which fatigues parts such as turbine buckets, small assemblies and test specimens by reverse bending has been announced by the *Special Products Div., General Electric Co.*, Schenectady, N. Y. Using a pneumatic resonant principle, the new machine vibrates the specimen undergoing test at its own resonant frequency, and closely simulates the actual dynamic loading conditions.

Basically, the machine consists of a fatigue motor. An optional accessory panel providing recording and direct reading of displacement, frequency, and temperature of the specimen, as well as automatic shutdown upon failure of the specimen, can be added at any time. A furnace which permits testing at temperatures up to 1700 F is also offered as optional equipment.

Close-up of fatigue machine showing specimen undergoing test.

The machine uses an opposed cylinder-type driving mechanism to vibrate the specimen. The specimen is positioned so that when small lightweight pistons are attached to it, the pistons are located between the openings of the two opposed cylinders. Air pressure is turned on, and pressure impulses from the cylinders vibrate the specimen. By adjusting the driving mechanism until the frequency of the pressure impulses is the same as the natural frequency of the specimen, highest displacement of vibration is obtained. The machine will continue to vibrate until failure occurs.

● The *Technical Processes Div.* of *Colonial Alloys Co.*, Philadelphia 29, announces the release to industrial and commercial users of its process known as Chemoxiding. All of the aluminums and aluminum alloys can be processed to produce glossy finishes which are relatively hard and corrosion resistant. The processing cycle of work includes short-time degreasing and cleaning, Chemoxiding and rinsing. Colorings range from a light gray through marbelized to light brown, depending upon the timing and alloys of aluminum used.

VERSATILITY

Lobdell-Nazel Forging Hammers are *ready at the push of a switch* to forge steel, wrought iron, brass or other metals.

Operator can vary the force of the blow, easily and quickly, whether light, medium or heavy while maintaining the rhythmic cadence *"timed" by the constant stroke frequency*—which coordinates the operator and hammer at the most efficient "working tempo."

Increased production of close tolerance forgings, reduced reheats, more uniform forgings* and lower machining costs are the results.

Anvil and base cast in one piece (an *exclusive* feature of Types 1B, 2B and 3B only) assures accurate alignment of dies, eliminates a costly, special, deep, concrete foundation and simplifies installation and relocation. Types 2B and 3B are *now* available for prompt delivery.

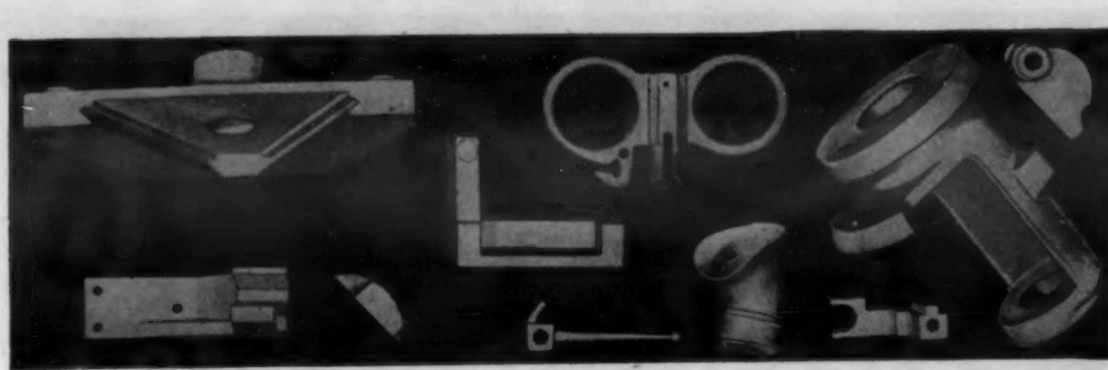
Visit BOOTH B 238 at the American Metal Congress in Atlantic City. See the Lobdell-Nazel Forging Hammer on display. Our engineers will be glad to answer your questions.

Write for catalog about Lobdell-Nazel, *BY FAR, the most widely* used air-actuated, motor-driven forging hammers in the world.

LOBDELL NAZEL FORGING HAMMERS

PAPER MILL MACHINERY • DILL "T-H" SLOTTERS • ROLLS FOR ALL INDUSTRIES

LOBDELL COMPANY ESTABLISHED 1836 **WILMINGTON 99, DEL.**



PRECISION INVESTMENT CASTING

Many small parts, covering a wide range of applications, are being produced in ferrous and non-ferrous metals by precision investment casting at substantial savings.

Production problems not easily met by conventional casting, forging or machining methods, may find a ready solution in this new, war developed method.

We can furnish, to established firms now engaged in precision casting, new equipment and a full line of operating supplies such as investments, pattern wax, flasks, tongs, fluxes, asbestos mittens, etc.

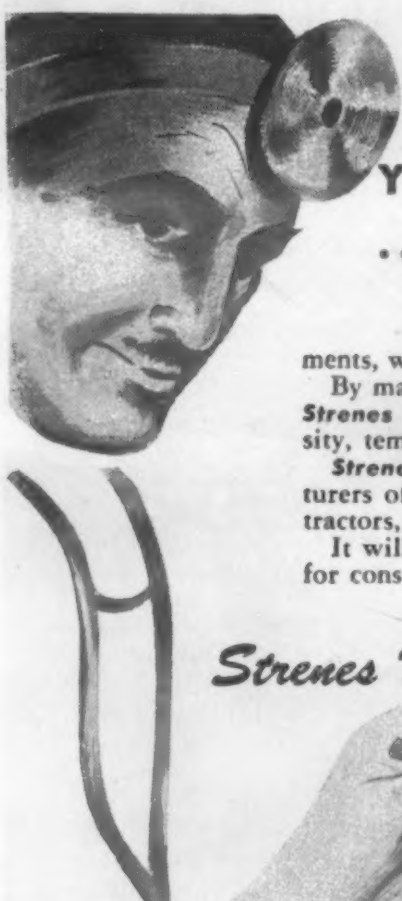
To manufacturers who wish to obtain specific pieces produced by precision casting methods we offer information regarding possible sources of supply. To those who wish to set up their own precision casting department, we supply detailed information regarding required equipment and operating supplies.

ALEXANDER SAUNDERS & CO.

Succ. to J. Goebel & Co.—Est. 1865

Precision Casting Equipment and Supplies

95 BEDFORD STREET NEW YORK CITY 14



℞

YOUR SYMPTOMS..........

.........OUR PRESCRIPTION

After diagnosing your drawing and forming requirements, we prescribe the type of *Strenes Metal* to fit the case.

By making slight changes in the formula, we are able to give *Strenes Metal* special characteristics in hardness, toughness, density, temperability, acid resistance, magnetic qualities, etc.

Strenes Metal cast dies have saved a lot of money for manufacturers of appliances, automobiles, blowers, caskets, implements, tractors, trucks, and vaults.

It will pay you to discuss your die problems with us. No fee for consultation, of course!

Strenes Metal DRAWING AND FORMING DIES

THE
ADVANCE FOUNDRY
COMPANY
100 Parnell St., Dayton 3, Ohio

Copper Tungsten and Silver Tungsten Alloys Formed into Rods and Bars

Copper tungsten alloys and silver tungsten alloys are now being produced in the form of rods, bars and inserts by *Ampco Metal, Inc.*, Milwaukee 4, Wis. The copper tungsten alloys can be used for resistance welding electrodes where they are held over a fairly long period at high heat and pressures or where water cooling is not available or adequate. These alloys can be used also for die facing and inserts, upsetting and forging dies, and similar applications.

The two silver tungsten alloys being produced by Ampco, in the form of rods, bars and inserts, are suitable for applications such as circuit breaker contact material and arcing tips, and for circuit breaker facing material and special welding applications.

Vacuum Return System Extends Usefulness of Blast Cleaner

A new blast-cleaning device for cleaning or refinishing metal, concrete, or other hard surfaces, is now in production by the *Vacu-Blast Co., Inc.*, 1054 Broadway, Burlingame, Calif. This machine has a vacuum return system, which permits no abrasives or other particles to escape into the open.

It is operated in much the same fashion as a household vacuum cleaner. No masks, goggles, or protective clothing are needed. The type of abrasives used depends upon the nature of the work to be done and the finish desired. Spent abrasive is reclaimed by the Vacu-Blaster and re-used as long as it remains effective.

The blast is controlled by a switch at the gun through which the abrasive blast is directed and through which grit and dust are picked up. The vacuum system operates continuously, returning grit and refuse to the reclaiming tank, where reusable grit is returned to the blasting system while dust and refuse are shunted off to a dust collector.

View showing essential parts of the blast-cleaning device which utilizes a vacuum return system.

Reclaimed abrasive is automatically dumped into the grit-supply tank at the close of each operating cycle. At the same time, the blasting assembly is automatically flushed with clean air to prevent possible clogging.

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— man will fly at incredible new speeds!

Since the first use of steam, 170 years ago, succeeding generations of engineers have known that the magic short cut to power was a turbine to directly utilize the hot gases of combustion.

But always the insoluble problem was metal—a super-alloy for the rotor of the turbine which had to spin madly at a speed in an inferno of heat and pressure that no steel had ever before withstood.

Then early in World War II, metallurgists of the Timken Company developed an amazing new steel, designated "16-25-6," which made possible the practical use of the AAF's turbosupercharger. Engineers wondered—would it be the answer to jet propulsion too? *It was!* Today an airplane that rips the sky faster than the speed of sound no longer is a wild dream.

Thus 16-25-6, the most important development in alloy steel to come out of the war, has made possible the war's most significant development in aviation.

Important advances in alloy steel logically come from a laboratory which devotes all its time and facilities to making better alloy steels. It could be well worth while to have the Timken Technical Staff suggest better alloy steels for you or better ways to use them in your product. Write Steel and Tube Division, The Timken Roller Bearing Company, Canton 6, Ohio. *Timken Bearings, Timken Alloy Steels and Seamless Tubes, Timken Removable Rock Bits.*

TIMKEN
Trade-mark Reg. U. S. Pat. Off.
Fine Alloy
STEEL AND SEAMLESS TUBES

ABC OF A JET ENGINE. Air enters the centrifugal compressor (A) and is forced to combustion chambers (B) where fuel is burned. Air and gases at high temperature, feed through diffuser vanes (C) driving the turbine wheel of 16-25-6 (D) and shaft (E) carrying the compressor. Hot gas exhaust (far right) is the jet which thrusts the plane forward.

In operation, hot expanding gases at 1700 degrees F. blast against the blades of the turbine wheel. Rim of the wheel reaches a red heat of 1200 degrees F. while spinning madly at 11000 R.P.M.

Besides ability to absorb this destructive punishment, 16-25-6 has excellent weldability, good machinability and high resistance to scale and corrosion—all vital qualities in the success of the turbojet engine.

★ YEARS AHEAD — THROUGH EXPERIENCE AND RESEARCH

How do *YOU* measure manpower?

Does manpower in your welding department mean numbers of men—or do you, more logically, measure manpower in terms of production?

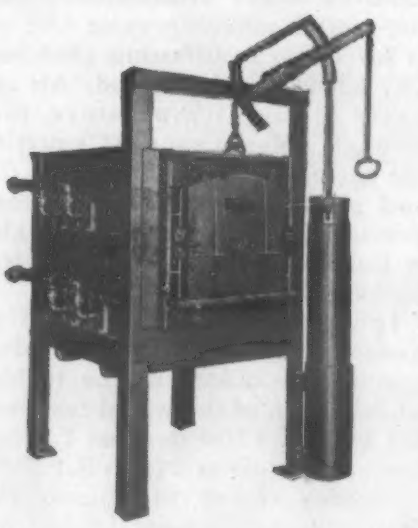
Because welding is becoming increasingly important in every phase of production today, it is important that your welding be done faster, better and more economically. If weldors are using cranes or spending time propping up, turning over and flopping their weldments, they are interrupting production and increasing costs on every foot of welding.

Investigate the demonstrated advantages of C-F Hand or Power-operated welding Positioners and see how they can help your weldors produce better, faster and more economical welding. Weldors can swing weldments into any position because every weld is downhand, larger electrodes can be used with resulting savings in time and material. For production welding, C-F Power-operated Positioners are unequalled—equipped with either variable or constant speed table rotation and power tilt, C-F Positioners have been setting new standards in production welding in many varied industries. Write for Bulletin WP-22 and more details. Cullen-Friestedt Co., 1314 S. Kilbourn Ave., Chicago 23, Ill.

C-F
positioned welds mean better, more economical welds

CULLEN-FRIESTEDT, CHICAGO 23, ILL.

JOHNSTON TOOL FURNACES



Complete combustion and a steady supply of uniform hot gases assure a quicker, more accurate, convenient and economical method of hardening, drawing and annealing of high speed or carbon steels and small tools.

Over and under fired—wide temperature range. Correct burner capacity maintained for high or low temperature operation. For high temperature all burners are used. For lower temperature, either the upper or lower set can be used.

Write for Bulletin MA-211

SAFETY THE JOHNSTON LINE DEPENDABILITY

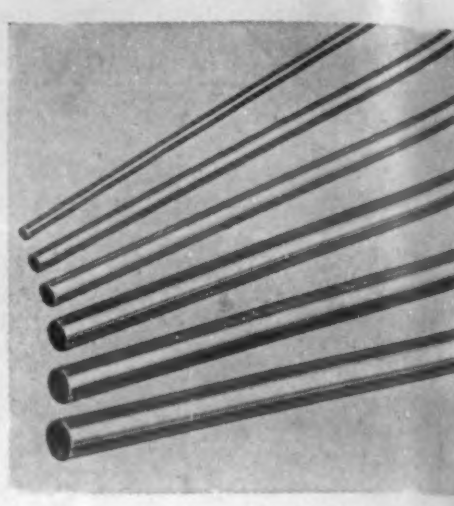
JOHNSTON MANUFACTURING CO. 2825 EAST HENNEPIN AVE. MINNEAPOLIS 13, MINN.

ENGINEERS & MANUFACTURERS OF INDUSTRIAL HEATING EQUIPMENT

Tungsten Carbide Available in Solid Extruded Rounds

Kennametal Inc., Latrobe, Pa., is now manufacturing a line of solid tungsten carbide extruded rounds, which are available in two grades, KE5 and KE7, with a Rockwell hardness of 89.0 and 91.0, respectively.

These rounds have been developed primarily for use as wear-resistant elements, and



Solid tungsten carbide extruded rounds are produced primarily for wear-resistant applications.

are suitable for such applications as guides, feeding fingers for automatic machines, rollers, guide rails, laps, scribers, points for engraving tools, thread checking wires, etc.

They are available, either rough extruded or centerless ground, in diameters of 1/32, 1/16, 3/32, ⅛, 5/32, 3/16, 7/32, and ¼ in., and in standard lengths in even inches from 1 to 10 in. These tungsten carbide grades can also be extruded in other forms, such as flats, tubes, triangles, squares and ovals.

Steam Cleaning Machine Has Many Industrial Applications

A new design steam cleaning machine, known as Model JO, has been announced by *Homestead Valve Manufacturing Co.*, Coraopolis, Pa. The unit is portable, steel-fabricated, electric-welded, with all machinery end-mounted and accessible. Oil or gas fired units are optional.

The machine can be used for industrial, automotive and farm cleaning applications, such as cleaning mill and industrial equipment; engines and chassis of passenger cars, buses and trucks; production, road and farm machinery.

Cleaning is accomplished by a mixture of steam, hot water and cleaning compound applied under pressure through a spray nozzle. Normal operating pressures range from 80 to 120 lb. at 90 gal. per hr. water capacity. Where powerful flushing and rinsing action and extra water capacity are required, the use of the Adjusta-Blast Gun is recommended, which increases water capacity up to 480 gal. per hr.

For mass-production, *Call on* COLGATE

Coasters, formed panels, canape trays, speakers . . . whatever the size of your part or assembly—when you want volume, you can count on Colgate. We have the facilities (mechanical presses up to 200 tons), the space (two large plants), the skilled manpower, and "know-how" for large production runs.

Colgate "Engineered Service" helps iron out your manufacturing problems, and our volume technique saves production time and trouble.

Have you a production job that calls for large volume? Call in Colgate. The assembly or part will be made right and turned out fast.

STAMPING • FORMING • DRAWING • WELDING • FINISHING • ASSEMBLING

COLGATE *Manufacturing Corporation*

AMITYVILLE, LONG ISLAND, NEW YORK

LIGHT METALS PRODUCTS

The KERR CENTRIFICO

CENTRIFUGAL CASTING MACHINE

Reputation: TOPS!

Standard for many years in the dental, jewelry and industrial fields, the "CENTRIFICO" has *earned* its reputation. This sturdy unit mounts an arm, jointed at the crucible end to minimize spillage. The standard arm takes flasks up to 3½" x 2½" and an auxiliary arm is available for flasks up to 4" x 5½". The "CENTRIFICO" is available as shown, or in an attractive black and grey transite cabinet.

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EST. 1918
Precision Casting Sales and Engineering
64 W. 48th St. • New York 19
Dept. M

See

the KERR CENTRIFICO in our new catalog, "Precision Casting by the Lost Wax Process" — 32 pages of information, equipment, and "know-how". Send for your *FREE* copy today!

Keep Up to Date on

CERIUM

Let us send you the latest information about CERIUM — particularly its uses in the light metals field. Two authoritative articles in a convenient file folder are yours on request.

CERIUM STANDARD ALLOY

Containing 45-50% Cerium—Balance principally rare earth metals.

Also available

CERIUM MASTER ALLOYS

with

ALUMINUM · CARBON · COPPER · GOLD · IRON · LEAD
MAGNESIUM · MANGANESE · NICKEL · SILICON · SILVER · TIN

OTHERS ON REQUEST

CERIUM METALS CORPORATION

522 FIFTH AVENUE • NEW YORK 18, N. Y.

Vertical Miller Converts to Die-Sinking and Profiling Machine

A general purpose, 16-in. vertical milling machine has been built by the *Cincinnati Milling Machine Co.*, Cincinnati 9. It can be provided with automatic control mechanisms which make it an automatic die-sinking and profiling machine.

The basic machine consists of a fixed height bed cast integral with the rear base. There are three styles of this machine. One of these is a general purpose milling machine. This is the basic machine provided with hand and power feeds to the table and cross-slide; hand feed only for vertical positioning of the spindle carrier.

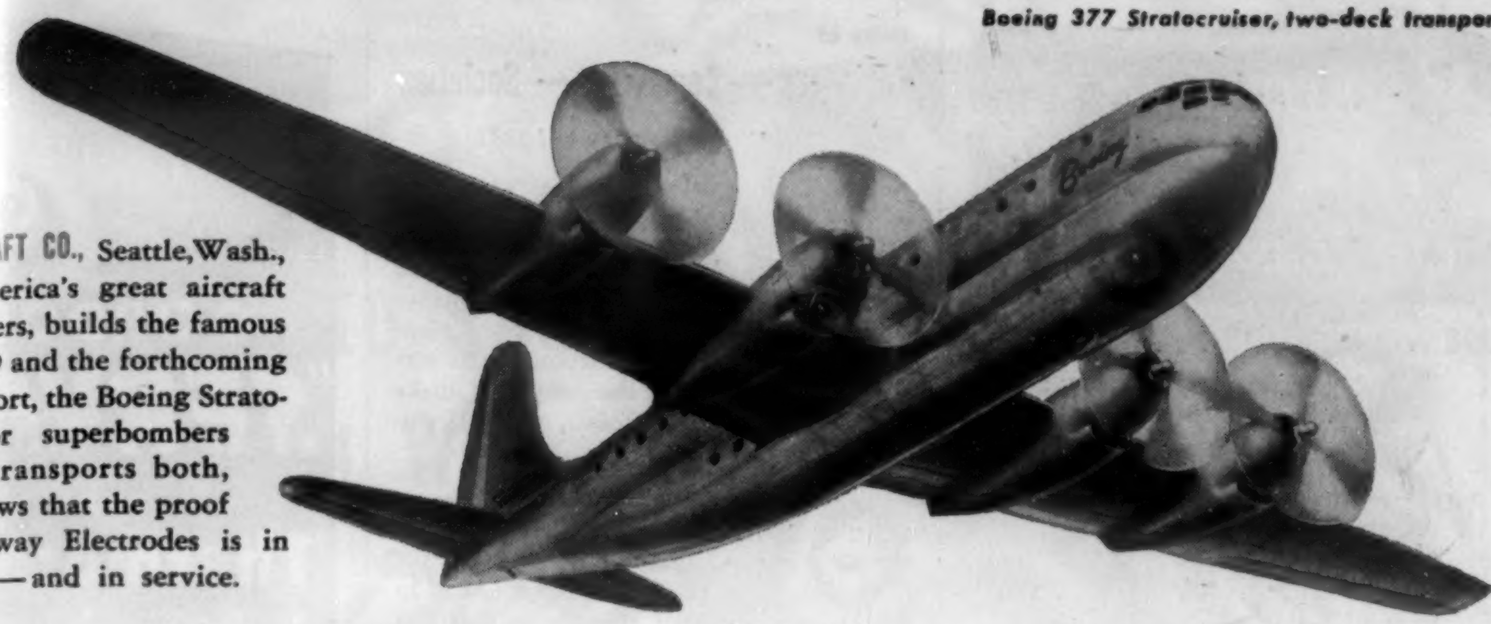
Another of the styles is a die-sinking machine with automatic depth control. It is the basic machine plus an automatic hydraulic tracer mechanism which provides automatic duplication of templates or master shapes. It may be used for either general purpose work, or for automatic, tracer controlled die-sinking. Another style variation is equipped with an automatic, hydraulic 360-deg. profiling mechanism for tracer controlled profiling work.

Close-up of 16-in. vertical milling machine being used as a die-sinker.

In the automatic profiling machine, the automatic hydraulic tracer mechanism actuates the movements of the table and cross-slide, under the control of a tracer finger, to duplicate profile shapes in a horizontal plane. The tracer finger will follow the complete outline of an external or internal template, in either clockwise or counterclockwise direction. This permits the selection of either "climb" or conventional cuts on both types of profile cut.

● To handle air, dust or other light solids under crowded conditions, the *Spiratube Div.* of the *Warner Brothers Co.*, Bridgeport 1, offers a self-extending, noncollapsible but retractable tubing. The continuous helical spring which forms the core is spiral-stitched into the fabric, so there are no exposed wires to create fire hazards or ridges to impede air or collect solids. The flexibility of the tubing makes possible its location close to the source of dust generators.

Boeing 377 Stratocruiser, two-deck transport



ING AIRCRAFT CO., Seattle, Wash., e of America's great aircraft nufacturers, builds the famous eing B-29 and the forthcoming pertransport, the Boeing Stratoiser. For superbombers d supertransports both, eing knows that the proof SMITHway Electrodes is in oduction — and in service.

BOEING . LAMB

AIRCRAFT COMPANY — GRAYS HARBOR COMPANY

Both use SMITHway Certified Electrodes

LAMB GRAYS HARBOR CO., Hoquiam, Wash., custom builders of Lamb Hot Plate and Cold Presses for the plywood industry, knows the value of A. O. Smith welding research, too. For custom jobs, no less than for production lines, SMITHway Electrodes take the guess out of welding—make welding the modern tool for all kinds of jobs in all kinds of shops.

Welding an all-steel Lamb Plywood Press

SMITHway *Certified* Welding Electrodes — Made by Welders . . . *for* Welders

Through Leading Distributors Everywhere

SMITHway A. C. WELDERS

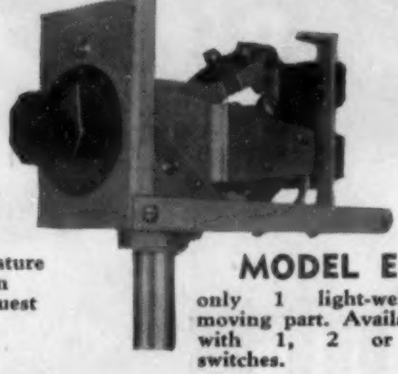
Six models, including 3 new models of 150-, 200-, and 250-ampere capacity. Heavy-duty models: 300-, 400-, 500-ampere capacity. Write for specifications and prices.

A. O. SMITH Corporation

NEW YORK 17 • PHILADELPHIA 5 • PITTSBURGH 19 • CLEVELAND 4 • ATLANTA 3
CHICAGO 4 • TULSA 3 • MIDLAND 5 • DALLAS 1 • HOUSTON 2 • NEW ORLEANS 18
SEATTLE 1 • SAN FRANCISCO 4 • LOS ANGELES 14
INTERNATIONAL DIVISION: MILWAUKEE 1

BURLING
TEMPERATURE
LIMIT SWITCHES

USE NO LIQUIDS . . . NO GASES



Literature on Request

MODEL E
only 1 light-weight moving part. Available with 1, 2 or 3 switches.

As a 3 switch model, Burling Model E is recommended for use (a) where load is divided into 3 parts, (b) where 1 switch is used for controlling, one as a high limit, one as a low limit, (c) to give definite stops or position to a 3 or 4 position diaphragm motor, (d) to give 3 speed control of variable speed motor.

- Accurate, Rugged, Dependable
- Corrosion and heat resisting tube
- Dial Pointer for easy setting
- Locking screw locks temperature setting
- Terminal plate has large screw terminals
- Snap-action Micro-Switch eliminates contact troubles
- Increased Adjustable range to 700-1000°
- Dimensions—7¼" x 2¾" x 3½"

MODEL V-I

For lower temperature range from 0-300°F. Available for minimum of —100° to maximum of 600°F. Usual adjustable range 50-150°, operating differential may be as small as ±¼ or as large as ±5°. Adjustable by screw and dial inside case. (Sizes 2¾" diameter × 4¼" high)

MODEL D
Adjustable range 200-500°F. Temperature range 0-1400°F. For use where temperature must be changed to suit operating conditions. Turn outside knob to change temperature setting. (Sizes 5½ x 2¾ x 2¾").

Instruments also Built to Specifications

Making Precision Controls for Over 10 Years

BURLING INSTRUMENT CO.
Springfield Ave. at Livingston St.
Newark, N. J.

News of

Engineers — Companies — Societies

(Continued from page 1088)

is now established in its new plant and offices at 13825 Triskett Rd., Cleveland 11.

The *General Electric Co.* has paid \$5,000,000 to the Reconstruction Finance Corp. for the big Ft. Wayne, Ind., plant where the company made turbosuperchargers during the war. The company will make fractional horsepower motors, and will employ 3000 persons.

The *Babcock & Wilcox Tube Co.*, Beaver Falls, Pa., has bought the welded boiler tubing plant at Alliance, Ohio, from the War Assets Administration for \$1,315,794.50. It is one of the country's largest and most modern specialty mills. The plant was built to produce 4,000 tons of ¾-in. to 4-in. welded tubing each month.

The *North American Philips Co., Inc.*, has completed the moving of its Wire Div. from Dobbs Ferry, N. Y., to Lewiston, Me. Here the company will draw, enamel and plate wires of extremely fine size in nearly all metals and alloys.

Borg-Warner Corp. has purchased from the War Assets Administration the manufacturing plant in Milwaukee which, during the war, was operated by the *A. O. Smith Corp.* for production of airplane propellers, the price having been \$1,500,000. The plant is for the company's newly-formed Wisconsin Transmission Div.

Bendix Aviation Corp. has organized a Special Products Development Group for research on controls and engine accessories for guided missiles and pilotless aircraft. Dr. Harner Selvidge, formerly of Johns Hopkins University, serves as director. The Group will operate laboratories exclusively for this work at Teterboro, N. J., and North Hollywood, Calif.

Westinghouse Electric Corp. has started production of a new electric motor at its Buffalo plant, the steel casing being of new design. The motor assembly is two-thirds the size of present models, but possesses up to 134% more power per lb.

The name of *Spicer Mfg. Co.* was recently changed to *Spicer Mfg. Div., Dana Corp.*, but there will be no change in any phase of the organization.

The *Payne Cutlery Corp.* has bought the *Compton Shear Co.*, Newark, N. J., and now claims to be the world's second largest maker of quality industrial shears and allied products.

Maas & Waldstein Co., Newark, N. J., maker of specialized production finishes, has acquired the *Smith-Davis Paint Co.*, Los Angeles.

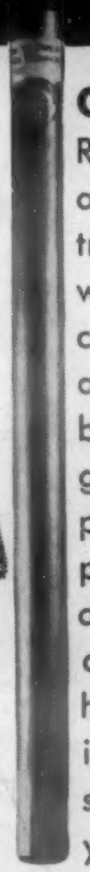
The *Peabody Engineering Corp.*, New York, is constructing additional plant facilities at Stamford, Conn., for manufacture of industrial burners and allied equipment.

For research and development in the atomic energy field, the *General Electric Co.* announces that its Chemical Dept. is now

(Continued on page 1310)

Lower Your Tube Replacement Costs with

GORDON'S
"SERVITE
TYPE R
Thermocouple Protecting Tube



For Cyanide and Salt Baths

GORDON SERVICE

Gordon Type R tubes, made and specially treated for use with thermocouples in cyanide and salt baths, not only give greater protection by preventing detrimental gas infiltration and penetration, but also have unusually long life in service. Join the many satisfied users and lower your tube replacement costs.

This is only one item in Gordon's complete line of protecting tubes for practically every application. Over a million of them have been put in service in the past few years. No matter what your requirements in protecting tubes are, both in regular and special sizes, consult Gordon first.

★ *Write today for bulletin and information*

CLAUD S. GORDON CO.
Specialists for 32 Years in the Heat Treating and Temperature Control Field
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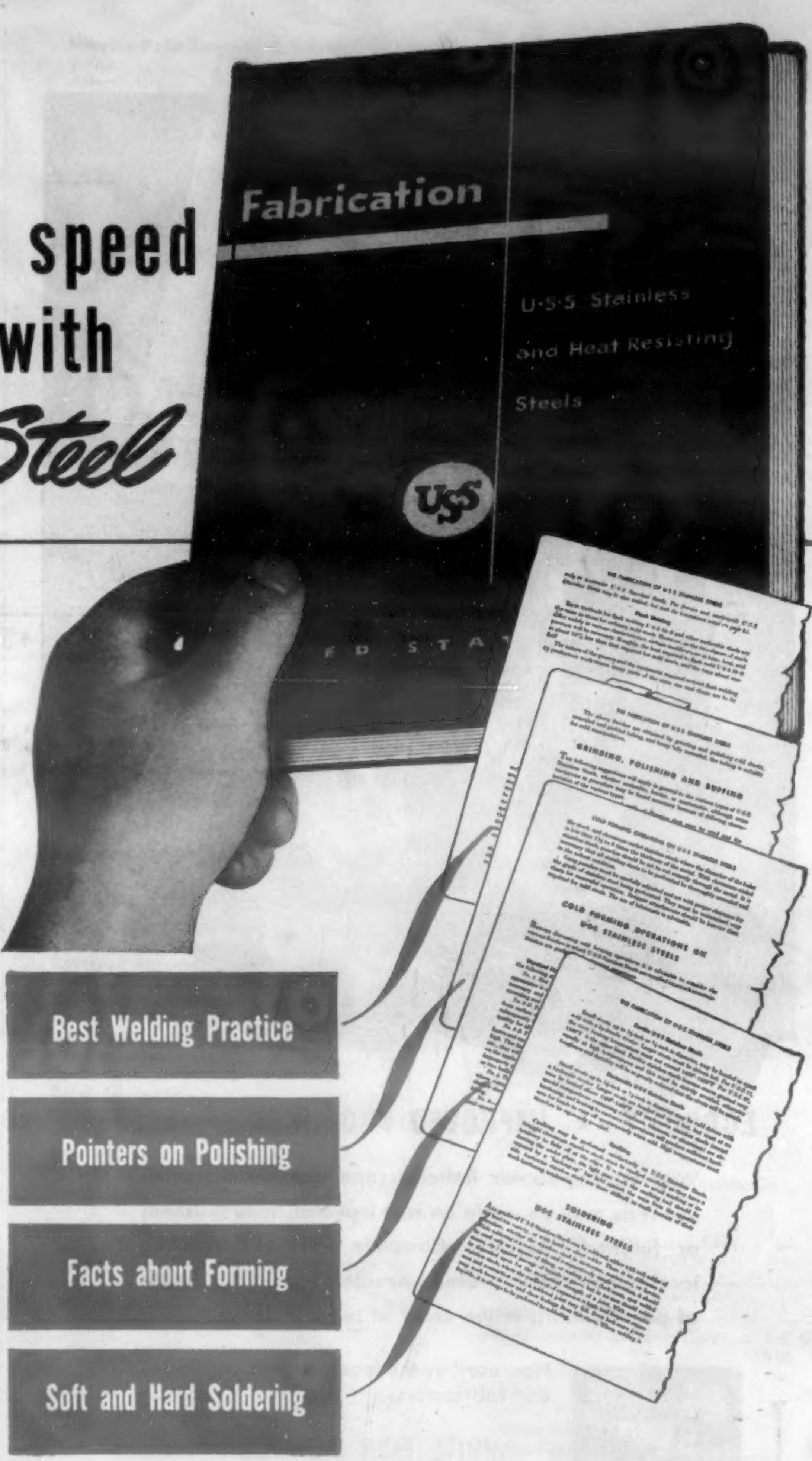
ere's help to speed your work with *Stainless Steel*



SUCCESSFUL fabrication with Stainless Steel needs exact methods. But these methods are difficult only when operations are inordinately severe or where an unusual alloy has had to be selected to withstand unusually severe conditions. In over 99% of the cases, Stainless Steel fabrication is *not* difficult . . . it is just *different*.

In this authoritative textbook, just off the press, these differences in fabricating techniques are thoroughly discussed.

Here in practical form are assembled the very latest findings on Stainless Steel welding, riveting, soldering and joint design—on machining, cutting, forming, annealing and pickling—on surface finishing and protection.

Here are listed for handy reference the various U·S·S Stainless Steels we produce—their physical properties and chemical compositions—the forms and sizes in which they are available—their resistance to various reagents.

This book is FREE—send for your copy. Use it as a guide to successful workmanship. And when unusual conditions confront you, ask for the assistance of our Stainless Steel specialists.

USS STAINLESS STEEL UNITED STATES STEEL

U·S·S STAINLESS STEEL

AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York*
CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
NATIONAL TUBE COMPANY, *Pittsburgh*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*
United States Steel Supply Company, Chicago, *Warehouse Distributors*
United States Steel Export Company, New York

We can supply U·S·S Chromium Nickel and Chromium Stainless Steel not only in many different analyses but in the widest, most complete range of forms, sizes and surfaces finishes anywhere obtainable. Our engineers are specialists in solving new and unusual problems in the use of Stainless.

UNITED STATES STEEL

responsible for the operation of the $34 000,000 Government-owned Hanford En neer Works at Richland, Wash., operati of the works having been turned over G. E. by the du Pont Co.

Castalloy Co., Inc., Cambridge, Ma has put into operation a new foun for making aluminum or magnesium p manent mold castings.

Holub Industries, Inc., is a new conce recently starting the manufacture of ele trical and mechanical products at 413 D Kalb Ave., Sycamore, Ill. The compa was organized by Bert E. Holub, for years with Ideal Industries.

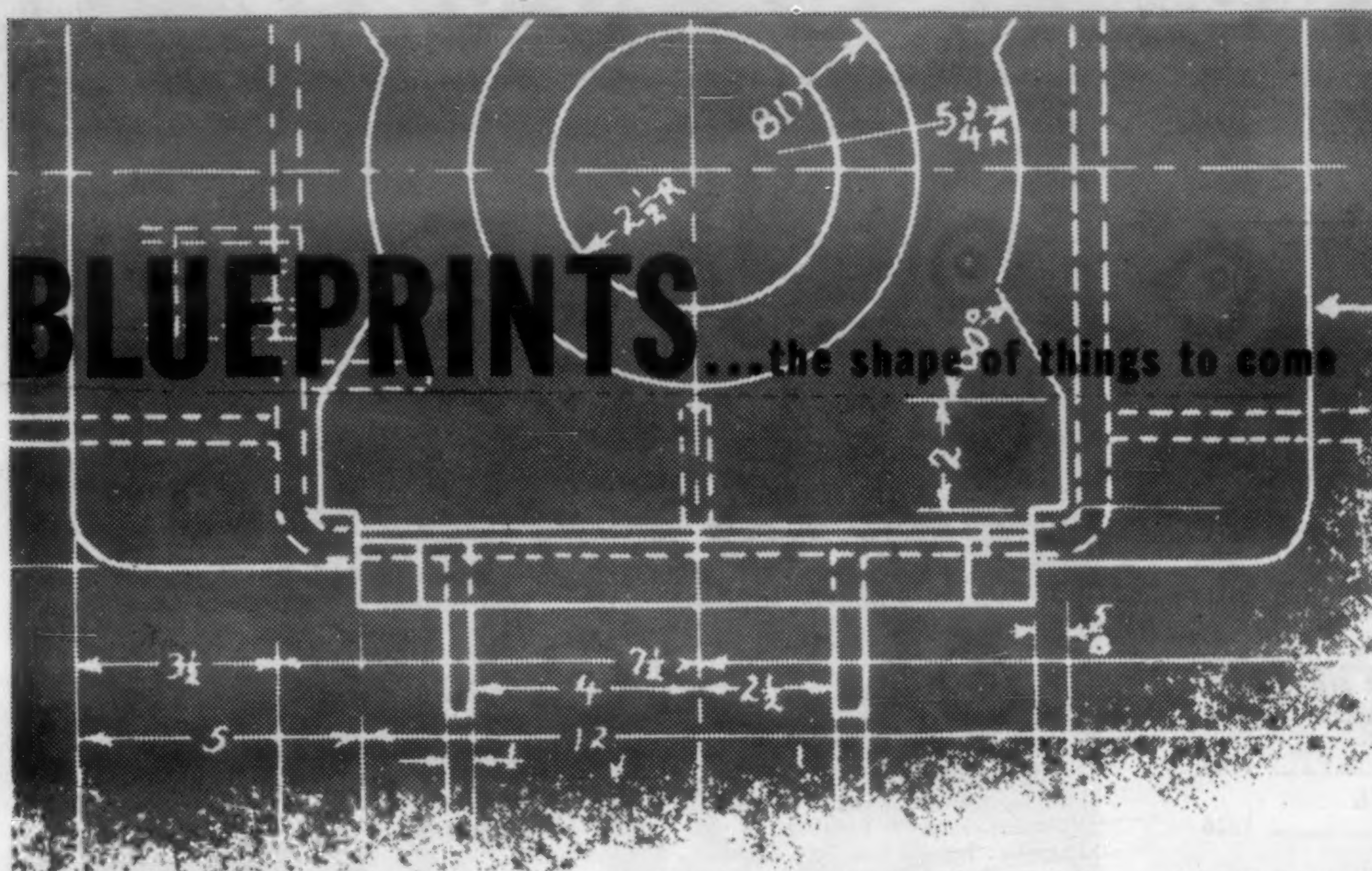
Societies

More details have been announced co cerning the *Stanford Research Institute*, non-profit organization sponsored by Sta ford University, California. All researc problems of industry are within its scop including pure and applied research in th physical, biological and social sciences, e gineering and mechanical arts. The direct is Dr. William F. Talbot, president an technical director, Fine Chemicals Div., S Chemical Corp. He is the inventor o Melamine resins and author of patents an technical articles.

The *American Society of Mechanic Engineers* has elected as president Eugen W. O'Brien, publisher of Atlanta, Ga. H was engineering consultant for the Wa Production Board and War Manpowe Commission and many New England en gineering firms . . . Several companies in the United Kingdom producing moder structural materials from light metals have formed the *Associated Light Metal Industries* to coordinate research and promotiona activities.

The *American Society for Testing Materials* has organized two new committees: One on asbestos cement products, and another on quality control of materials . . . According to F. G. Walls, past president, *American Foundrymen's Assn.*, there are 5000 ferrous foundries and 3,040 nonferrous in the United States. The ferrous consist of 2,879 gray iron, 383 steel and 139 malleable . . . The *Society of the Plastics Industry* and *New York University* are establishing the country's first course in plastics retailing.

The resumed *Western Metal Congress and Exposition* will be held in the San Francisco-Oakland Golden Gate area for six days, starting March 22, 1947, the last previous event having been in Los Angeles in 1941. Technical sessions and exhibits will be housed in the two large civic auditoriums at Oakland . . . A plea for higher standards in the engineering profession through more stringent requirements for college degrees is voiced by Frederick S. Blackall, Jr., president New England Council, *A.S.M.E.*



BLUEPRINTS...the shape of things to come

Shot-Peening Aluminum Alloys

Shot-peening has been gaining in prestige in preparing ferrous metals to withstand fatigue (as witness the top MATERIALS & METHODS Award announced in this issue), the surface of the metal being placed under compressive stress. Watch for its use to stop leaks. The trouble with many die-cast aluminum alloy components is that they are porous and where they must contain air or fluids they leak. It has been found that by shot-peening both sides of a leaking casting, the trouble is virtually eliminated. Experimenters subjected some castings to 50 psi. air pressure, while others were hydraulically tested at up to 2000 psi., resulting in 90% units without leakage and only slight seepage in the other 10%.

More Speculum Applications

Plating with speculum, the tin-base alloy, is developing well, with more applications found constantly, such as household appliances, flashlights, etc. Such intricate mechanisms as cash register parts can be successfully plated. Such plating has excellent throwing power. Deeply recessed parts have been successfully treated.

Precisely Accurate Thermometer

A new thermometer bids fair to be so accurate it will find wide usage in checking other thermometers. The conventional porcelain or mica body is replaced by a quartz-spiral covered with spectrally clear platinum. It measures temperatures from minus 180 to 660 C. As far as is known it has not been made available in this country, having been developed by the Institute of Physical Problems and the Research Institute of Weights & Measures of U.S.S.R.

Hey, Pop, Pass the Mustard!

Here it is folks—and stop drooling! We've been promising you this for months and you may be having it when this is printed—a hot dog cooker by electronics or dielectric heating, call it what you will. It can cook in 10 sec. and, we understand, heats from the inside out, as all thoroughbred dogs should be heated. Oh, well, if you want to be technical—2½ kw. a.c., converted to r.f. by oscillator tubes, operating with 3000 v. of d.c. supplied by standard rectifier tubes. Relays protect tubes and circuits against overloads. But what's to protect your stomach, Pappy, from overloading?

Silver-Mag Solder for High Heat

A German silver-magnesium solder, capable of withstanding temperatures as high as those found inside gas jet turbines, may prove useful to many American manufacturers. Possible uses here would be in fabrication of stainless steel heat exchangers, exhaust manifolds, gas turbine parts and general chemical equipment. The solder is 85% silver and 15% magnesium. The solder has a melting point of 1790 F and retains its high strength up to 850 F.

Nylon Soft Hammers

Nylon is proving as versatile as the triple-threat player on a football team. You will soon find on the market a soft impact hammer with faces of molded nylon. In the testing room nylon on soft hammers was found to outlast all plastics, rawhide and soft metals. Such hammers handle well, have no rebound, do not chip, and retain their shape.

Synthetic Crystal Detectors

Remember the crystal detector in the original radio receiving sets with which contact was made by a "cat's whisker"? It finally became unsung and forgotten. Then came microwaves and need to convert minute energy to amplifiable frequencies. A silicon of controlled composition was devised as a microwave detector and was used in long-distance microwave radar. These synthetic crystal detectors are destined to play a big role in electric circuits of the future. Expect them to reappear in various forms in radio sets.

Improvements in Steel

Forthcoming improvements in steel processing and the product have been outlined by an expert. New and improved methods of beneficiating iron ore, improved methods of washing and blending coal, refractories standing up under higher temperatures and with longer life, all are in the offing; also, ingots with greater interior soundness and made to close analysis ranges and better testing, based on electronics and supersonics. New rolling mill equipment will provide finer finishes and greater output. We will see some steels withstanding lower temperatures than ever before; some, higher temperatures. Multiple low-alloy steels will partly replace simpler compositions.

Wood Waste in Plastics

Up to 80% of wood is wasted at the lumber mills. Stockyards long ago utilized "all but the pig's squeal," and the same bids fair to materialize with wood. The plastics industry is starting seriously to use wood-resin combinations to make furniture parts, industrial accessories, sheathing board, etc. The main difficulty to be solved is the small pieces in which this waste exists.

New Machine for Ball Races

A process for making races for ball bearings invented by the Germans may be adapted here. The machine works on the principle of a tire rolling machine. An advantage over the upset forging process is that is eliminates costly forging dies. Moreover, two sizes of the machine could produce a complete range of races, including those with outside dimensions up to 800 mm. (31.49 in.). Handling of heavy forging bars is eliminated, and smaller furnaces to heat blanks are usable.

Silicone Everlasting Paints

A newspaper recently announced that automobiles will in the future be painted with sand. Which is their sensational way of saying, with silicones, of which silicon is an important ingredient. Engineers who are developing the new silicone paint say it will give a lifetime finish, retaining its original color and gloss indefinitely. In fact, brighter and clearer colors will be obtainable. They say, too, it will stand more punishment than previous finishes.